Summary of a Review of Fraser River Test Fisheries

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Executive Summary

The Pacific Salmon Commission (PSC), or its predecessor the International Pacific Salmon Fisheries Commission, has operated test fisheries to obtain data required to inform bilateral decisions of the Fraser River Panel since the 1960s. These test fisheries are implemented under the Pacific Salmon Treaty. The specific purpose(s) of each test fishery varies, but collectively their data are used with information from the in-river hydro-acoustics program to provide in-season estimates of timing and run size of Fraser River sockeye and pink salmon. This information is essential for the Fraser River Panel (the Panel) to fulfil its responsibilities for in-season harvest management and allocation decisions to ensure conservation objectives are met. The current test fisheries cover three key geographic areas: the northern and southern marine approaches to the Fraser River and the lower Fraser River. The core marine test fisheries are located toward the seaward end of each approach route to provide reliable and representative information as early as possible in advance of potential marine fisheries. In the lower Fraser River, test fisheries coupled with acoustics provide estimates of the abundance of fish that remain following any marine harvest (i.e., the abundance of fish available for spawning escapement and that would be available for potential harvest by fisheries within the Fraser River and its tributaries). Test fisheries provide data related to catch (by stock and species), as well as effort, and other biological information. These data are then used as inputs to the PSC models to assess abundance, timing, diversion rate, stock and species composition, vulnerability, and catchability.

There were various drivers that served as a motivation for this review. Initially, concerns were raised on a regular basis about in-season availability of test fishing data, potential biases and limitations in data, challenges with some specific test fisheries, ongoing interest in other types of information that could be used to inform decision making, and inevitable changes over time that can affect their performance and the ability for in-season run size models to adequately predict run size. In addition, recent events (poor sockeye returns) have led to competing pressures on catch retention levels in test fisheries and therefore the desire to ensure that individual test fishing program elements are justifiable and cost-effective. Lastly, a review of Fraser River hydro-acoustics is underway and there are benefits in reviewing test fisheries at the same time since these two components provide key elements of the Fraser River sockeye and pink salmon assessment program.

Given these drivers and the desire to maintain a rigorous program, the Panel requested funding to conduct a workshop to "Improve Fraser River test fisheries and run size estimates" that would help the Fraser Panel understand factors that affect test fishery performance in addition to exploring the use of alternative data sources in run size assessments. The purpose of this workshop was to identify opportunities for refining / improving the test fishery program to ensure it provides high quality information for decision making. This review focused on providing a technical assessment of Fraser River Panel-related test fisheries in freshwater and marine environments. This review did not involve an exploration of different policies, such as alternative administrative / funding arrangements that could support operation of these test fisheries. The intent was that the key insights and broad recommendations from this review would be used by the Fraser River Panel to develop specific recommendations and identify next steps to be considered by the Commission.

This review compiled existing information on historic and existing test fisheries, gathering technical input from a variety of experts in both Canada and the United States, as well as undertaking some technical analyses. The review involved four specific components:

- **Component 1** involved reviewing and synthesizing existing information and past studies related to Fraser River test fisheries. An evaluation framework was also developed to provide a consistent and transparent approach for evaluating potential refinements based on the key performance considerations that matter to scientists and decision makers.
- **Component 2** involved convening a 2-day workshop to identify alternative options for test fisheries / data that could be used to replace or add to the information that is currently collected, and gathering input on priority next steps to evaluate after the workshop.
- **Component 3** involved completing a set of targeted technical analyses and research activities to provide answers to some of the questions that had been prioritized following the first workshop that could be addressed with readily available information / data (see Table 1).
- **Component 4** involved convening a second 2-day workshop to review findings from the technical analysis completed since the first workshop, and to gather input on immediate, near term, and longer term needs to inform future decisions regarding refinements to test fishery programs.

This review recognized that proposed refinements have different strengths and weaknesses. A decision to implement a particular refinement requires a consideration of the trade-offs among potentially competing factors. Hence, a framework was developed to evaluate potential refinements to the test fishery programs based on a set of performance criteria. These criteria included:

- **Value / relevance of the information to Fraser River Panel management decisions**
    - Type of information
    - Timeliness of information
    - Quality of information
- **Financial**
    - Cost to implement
    - Revenue from sample fish
- **Fish mortality**
    - Target species
    - Non-target species

Table 1: Nine priority activities identified in the first workshop. Activities subject to further analysis are marked with two asterisks (**). Numeric order is not intended to imply relative priority.

1. Developing decision rules to guide pre-season planning and in-season deployment of test fisheries under different scenarios and conditions.
2. Reviewing existing test fisheries to better understand their perceived value and the non-Panel use of the data they generate.**
3. Developing a strategy for managing and incorporating other sources of information and data relevant to in-season fisheries management.
4. Improving timeliness of in-season information by the use of data from fisheries more seaward than current configuration.**
5. Evaluating alternative configurations of test fisheries in Johnstone Strait.**
6. Evaluating representativeness of purse seine test fisheries in Areas 12 and 13.**
7. Reviewing the current suite of in-river test fisheries.**
8. Evaluating alternative technologies for estimating in-season abundance in the marine environment.
9. Improving the understanding of holding patterns of late-run sockeye and pink salmon in the Strait of Georgia.

Below is a summary of the key findings from the research activities that were prioritized for further analysis.

- Reviewing existing test fisheries to better understand their relative value and non-Panel uses.
  - Data from test fisheries, as well as PSC information products, are used by many others beyond the Panel. Data are predominately used by others for in-season purposes, with many confirming the Panel-agreed purposes and uses of data from the program, and others noting that catch and effort data are also useful for representing catch of other species.
- Improving timeliness of in-season information by the use of data from fisheries more seaward than current configuration.
  - Quantitative analyses indicated that there are weak to no correlations between the timing and abundance of Fraser sockeye observed in more seaward fisheries examined based on the very limited data that was available and the actual timing and abundance of sockeye salmon at the Fraser River.
  - An evaluation of having data that is the same quality as hydro-acoustics data available sooner (i.e., more seaward) did not improve run size estimates.
- Evaluating alternative configurations of test fisheries in Johnstone Strait.
  - Analyses revealed that there was little evidence that Naka Creek is a more representative location for the gillnet test fishery than Round Island. The marine abundance predicted based on the Naka Creek CPUE tended to be biased low, although there was a minor increase in precision (4%). With further investigation, Naka Creek could prove to be as good of a location as Round Island, but this would need to be established by running both test fisheries concurrently for several years.

    - For most years there are limited differences in run size estimates when including Area 13 versus relying on Area 12/20 CPUE data only. These differences can either decrease or increase error in the run size estimate. The analysis did indicate improved run size estimates when Area 13 is conducted in lower run size years.
- Evaluating representativeness of purse seine test fisheries in Areas 12 and 13.
    - Catch from three of the test fishing set locations in Areas 12 and 13 do not appear to correlate to the overall abundance of fish migrating through the strait. Given the relatively limited number of catch samples at these locations, and due to the uncertainty in the catchability estimate used to convert CPUE into daily abundance estimates, the improvement in the daily CPUE estimates by removing these locations are insufficient to substantially improve resulting abundance estimates.
    - Analyses suggest that the available CPUE data from ITQ fisheries that was examined generates similar in-season abundance predictions to those obtained from Areas 12 and 13 test fishery data. However, because estimates of Area 12 and Area 13 ITQ catchability were lower than in the test fishery, their consideration as an additional source of information for in-season run size estimation would require a separate catchability estimate to be derived before ITQ data could be used to predict run size in-season.
- Assessing a reduction in gillnet test fishing boats operating in Area 20.
    - Reducing the number of gillnet test fishing boats operating each day in Area 20 from two to one results in less precise (and at high abundance biased) estimates of CPUE, which leads to a modest increase of in-season run size error. Beyond the assessed analytical value of having two vessels operating in Area 20, given it geography, operator and vessel safety were identified as a consideration for operating two vessels in this area.
- Reviewing and refining the current suite of in-river test fisheries.
    - Although in-river test fisheries were identified as a core component of the program, it was also recognized that there may be opportunities to reconfigure them. The analysis to-date has not provided a definitive basis for deciding upon the optimal configuration of in-river test fisheries.

Discussions at the second workshop were informed by findings from the research and technical analyses summarized above, leading to adjustment to the list of priority activities from the first workshop. The priorities for further consideration include:

- Reducing Area 20 gill net test fisheries from two boats to one.
- Improving data reporting from Food, Social, and Ceremonial (FSC) / Ceremonial and Social (C&S), and Individual Transferable Quota (ITQ) fisheries for in-season use.
- Exploring consolidation of in-river test fisheries.
- Improving sampling design of Area 12/13 site locations and accounting for local environmental variables.
- Testing the use of marine sonar to assess late-run holding in the Gulf.
- Improving pre-season planning and administration of the test fisheries schedule.
- Rationalizing test fisheries not used in run-size assessment.
- Reducing redundancies overall throughout the test fishery program.
- Exploring potential for data from other seaward areas / fisheries to provide earlier information.
- Improving marketing and value of fish retained during test fishing activities.

These priorities were seen as important to consider in the short and long term, some of which require further discussion (e.g., removing test fisheries not used in run-size assessment), while others require additional research to understand a clear path forward (e.g., exploring consolidation of in-river test fisheries). What became clear is that there remain tradeoffs among the pros and cons for many of these priorities that have yet to be weighed by decision makers if they choose to implement them.

This project's intent as proposed to the SEF by the Fraser Panel was to explore "Improving Test Fisheries and Run Size Estimates". Overall, this review was seen as a success by the advisory committee and among participants since it was able to engage a wide range of perspectives to constructively explore many potential refinements to the test fishery program and their ability to satisfy the varied needs of decision makers (i.e., maximize the value of information, minimize cost, and minimize fish mortality).

Despite the varied discussions and many considerations brought forward, there are five broad recommendations that emerged from this review. These recommendations are intentionally broad since the specific findings related to individual refinements are described elsewhere in this report and there remains a need to further clarify the details around how many refinements would be implemented and how they align with the priority needs of the Parties. These recommendations include:

(1) Improving pre-season planning and administration of the test fisheries schedule (an unaddressed priority that was identified at the first workshop).
(2) Supporting integration of data from other sources that provide valuable information in a cost effective way for the Fraser River Panel (such as through ITQ, FSC, C&S, and/or other more seaward fisheries).
(3) Leveraging the key findings from this review, technical expertise of PSC staff, and priority refinements identified by participants to confirm their value and need (e.g., reducing Area 20 gill net test fisheries from two boats to one, consolidating in-river test fisheries, integrating data from other sources).
(4) Evaluating and implementing potential refinements to test fisheries using a phased process (i.e., to maintain the scientific rigor and integrity of the program).
(5) Exploring alternative administrative / funding arrangements for test fisheries between the Parties, since persistent funding shortfalls will have implications on the scope of refinements that might need to be implemented.

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1 Introduction

1.1 Background on Fraser River Test Fisheries

The Pacific Salmon Commission (PSC), or its predecessor the International Pacific Salmon Fisheries Commission, has operated test fisheries to obtain data required to inform bilateral decisions of the Fraser River Panel since the 1960s. These test fisheries are implemented under the Pacific Salmon Treaty.[1]

The specific purpose(s) of each test fishery varies, but collectively their data are used in conjunction with information from the in-river hydro-acoustics program to provide in-season estimates of timing and run size of Fraser River sockeye and pink salmon management units (Table 2). This information is used by the Fraser River Panel (the Panel) to fulfil its responsibilities for in-season harvest management while ensuring conservation objectives are met. Each season, the Panel must address two critical questions. First, is the run size sufficient to meet escapement goals? Second, will there be a Total Allowable Catch (TAC)? If there is a TAC, the Panel must determine: (a) how big is the TAC, (b) when, where and to what level of effort should fisheries occur, (c) should some areas be avoided, and (d) which types of gear should be deployed. In odd-numbered years, these questions must be addressed for both sockeye and pink salmon. The information from the test fisheries program is a critical input to the Panel's decisions.

The current test fisheries (Figure 1) occur in three key geographic areas: the northern and southern marine approaches to the Fraser River (Johnstone Strait, and the Strait of Juan de Fuca, respectively) and the lower Fraser River. Both marine approaches are included as the portion of fish returning along each route can vary highly across and within years. Along both of the marine approaches, the core test fisheries are located toward the seaward end of the approach to provide reliable and representative information as early as possible. Test fisheries coupled with acoustics in the lower Fraser River provide estimates of the abundance of fish that remain following any marine harvest, the abundance of fish available for spawning escapement, and potential harvest by fisheries within the Fraser River and its tributaries.

The raw data provided by the test fisheries are catch by stock and species (based on sampling), and effort, as well as other biological information such as age, sex, and weight. Collectively across the test fishery program, these data are used as inputs to the PSC models to assess abundance, timing, the diversion rate, stock and species composition, vulnerability,[2] and catchability.[3] In addition to providing inputs into PSC's in-season modeling process, the data from various test fisheries are sometimes used to project the magnitude of catches in potential fisheries. Individual test fisheries can also provide relevant information on local abundances for certain users. Finally, many of the test fisheries also catch non-target stocks and other salmon species, which provides an incidental source of information on those stocks and species.

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[1] An August 13, 1985 Diplomatic note between Canada and the United States directs various parts of Pacific Salmon Treaty (PST) implementation. Paragraph 1.(c) in that note authorizes the Fraser River Panel to "conduct test fishing on Fraser River sockeye and pink salmon". Annex IV, Chapter 4 of the PST (paragraph 3) stipulates that the catch in Panel authorized test fisheries will be deducted from total run size in determining the international TAC's available to each country.

[2] Vulnerability refers to which stocks are susceptible to capture by particular gear in particular areas.

[3] Catchability refers to the proportion of the available abundance captured per unit of effort.

The deployment of different test fisheries varies in time (see Figure 2 and Figure 3). Collectively, they span up to 90% of the sockeye/pink period of return migration (generally late June – early September). However, individual test fisheries have different start and end dates because they are operated to obtain specific types of information for a defined period of time. The timing of operation varies across and within seasons, especially in relation to abundance and timing, being initially based on forecast abundance and then adjusted based on estimated abundance. For example, when the pre-season estimated abundance is high enough to potentially support a TAC, then the full operation of the test fishery program may be desirable to ensure that harvest management decisions can be made with the greatest confidence in a timely manner. If the actual abundance turns out to be much lower, then once it is confirmed that the run will not support a TAC it may be desirable to stop some test fisheries early to reduce program costs. However, if the actual abundance is high enough to support a TAC, then it will be important to continue to have high quality information on which to base ongoing management decisions, although some of the test fishery data may then be supplemented by data from the commercial fisheries. While the identification of the magnitude of the TAC is an important driver of test fishery duration, test fisheries may continue operation even during periods when little or no TAC is available, for other purposes, such as monitoring escapement or estimating daily abundance. For example, stocks with limited, or no TAC, are typically managed to constrain harvests within some acceptable exploitation rate limit (i.e., a Low Abundance Exploitation Rate or LAER). When a stock is being managed under a LAER limit, harvest impacts accrue as bycatch in fisheries directed on more abundant sockeye stocks or other species. Thus, while the scale of fisheries decisions are much reduced when there is no TAC, the need for estimates of abundance remains. Regardless, past experience has shown that it is prudent to start with a more comprehensive test fishery program and adjust downwards as appropriate because it is easier to scale back than it is to ramp up operations. In recent years the start of some test fisheries have been delayed to reduce the impact on certain stocks due to very pessimistic forecasts; primarily associated with of the early portion of the sockeye return, specifically Early Stuart and early components of the Early Summer stock group.

Table 2: A concise summary of current and past test fisheries. See Attachment A for a more detailed summary of these test fisheries.

		Region			Period of Operation						Gear				Management Group					Monitoring Purpose			Data Uses												Estimate Abundances in:				
		Fraser River & Georgia Strait	Juan de Fuca Strait & US Waters	Johnstone Strait	1960s	1970s	1980s	1990s	2000s	2010s	Gillnet	Purse Seine	Troll	Reefnet	Early Stuart	Early Summer	Summer	Late run	Pink	Qualitative	Quantitative	Research	Timing	Abundance	Stock ID	Diversion	Specie composition	Harvest rate	Late run management	Pink management	Project Mission escapement	Project abundance entering US	International allocation	Verification	Marine areas	Commercial catches	US Waters	Strait of Georgia	Fraser River at Mission
	CURRENTLY OPERATED IN-SEASON FRASER RIVER PANEL APPROVED CORE FRASER SOCKEYE & PINK SALMON ASSESSMENT TEST FISHERIES (used by PSC Staff in-season for bilateral assessment of Fraser sockeye and pink salmon)																																						
1	Area 20 gillnet		X		X	X	X	X	X	X	X				X	X	X			X	X		X	X	X	X					X	X	X		X	X	X		X
2	Area 20 purse seine		X		X	X	X	X	X	X		X					X	X	X	X	X		X	X	X	X			X	X	X	X	X		X	X	X	X	X
3	Area 12 Gillnet Round Island			X			X	X	X	X	X				X	X	X			X	X		X	X	X	X					X		X		X	X	X		X
4	Area 12 purse seine Blinkhorn			X			X	X	X	X		X					X	X	X	X	X		X	X	X	X			X	X	X		X		X	X	X	X	X
5	Area 13 purse seine			X				X	X	X		X					X	X	X	X	X		X	X	X	X		X	X	X	X		X	X	X	X	X	X	X
6	Area 29 Cottonwood Gillnet	X			X	X	X	X	X	X	X				X	X	X	X	X	X	X		X	X	X		X		X	X	X		X					X	X
7	Area 29 Whonnock Gillnet	X			X	X	X	X	X	X	X				X	X	X	X	X	X	X		X	X	X		X		X	X	X		X					X	X
8	Area 29 Gulf Troll	X					X	X	X	X			X					X		X	X		X	X	X				X		X							X	
	CURRENTLY OPERATED IN-SEASON FRASER RIVER PANEL APPROVED SOCKEYE & PINK SALMON TEST FISHERIES (provide supplemental information on Fraser sockeye and pink salmon and other species, but not used by PSC Staff for run-size assessment models)																																						
9	Area 12 Gillnet Naka Creek			X					X	X	X				X	X	X			X				X	X										X	X			
10	Area 4B, 5 Gillnet (US)		X						X	X	X				X	X	X			X			X	X	X							X	X			X	X		
11	Area 7 Reefnet Observation (US)		X					X	X	X				X		X	X	X	X	X			X	X	X							X	X			X	X		
12	Qualark Gillnet	X							X	X	X				X	X*	X*	X*	*			X			X		X							X					

* Note: Qualark TF only provides information for stocks that migrate past Qualark. Details for each management group are provided in comment boxes.

		Region			Period of Operation						Gear				Management Group					Monitoring Purpose			Data Uses												Estimate Abundances in:				
	HISTORIC FRASER RIVER SOCKEYE & PINK SALMON TEST FISHERIES (no longer operated. They were presumably operated to provided inseason assessment of Fraser River sockeye and pink salmon)																																						
13	Area 20 Sherringham 2nd purse seine								X			X										X													X				
14	Area 20 expanded purse seine test fishery								X			X										X													X				
15	Area 16 Purse Seine							X				X								X																			
16	Area 17 Trail Island Gillnet						X				X									X																			
17	Marine FSC Gordon Group co-ordinated purse seine								X			X										X													X				
18	Humpback Bay								X			X								X																			
19	Queen Charlotte Island Troll							X					X							X															X				
20	West Coast Vancouver Island Troll						X	X					X							X															X				
21	US Strait of Juan de Fuca Gillnet					X	X				X									X																X	X		
22	Lummi Island Gillnet					X					X																												
23	Area 7 Gillnet					X	X	X			X									X																X	X		
24	Puget Sound Purse Seine					X	X	X				X								X																X	X		
25	Point Roberts Gillnet					X	X	X			X							X		X																		X	
26	Point Roberts Purse Seine						X	X				X						X		X																		X	
27	Area 29 Gulf Purse Seine						X		X			X								X																		X	
28	Area 29 Gulf Gillent					X	X	X			X									X																		X	
29	Area E Gillnet Assessment								X		X																												
30	Mission Gillnet								X	X	X									X	X																		X
	NON-FRASER SOCKEYE & PINK SALMON TEST FISHERIES (target species other than Fraser sockeye and Pink salmon but provide PSC Staff supplemental in-season bilateral management information)																																						
31	DFO - Albion Chinook and Chum Gillnet	X					X	X	X	X	X									X	X						X												X
32	DFO - Upper Johnstone Striat Chum Seine			X								X								X	X														X				

This information is not provided in the detailed summaries of test fisheries

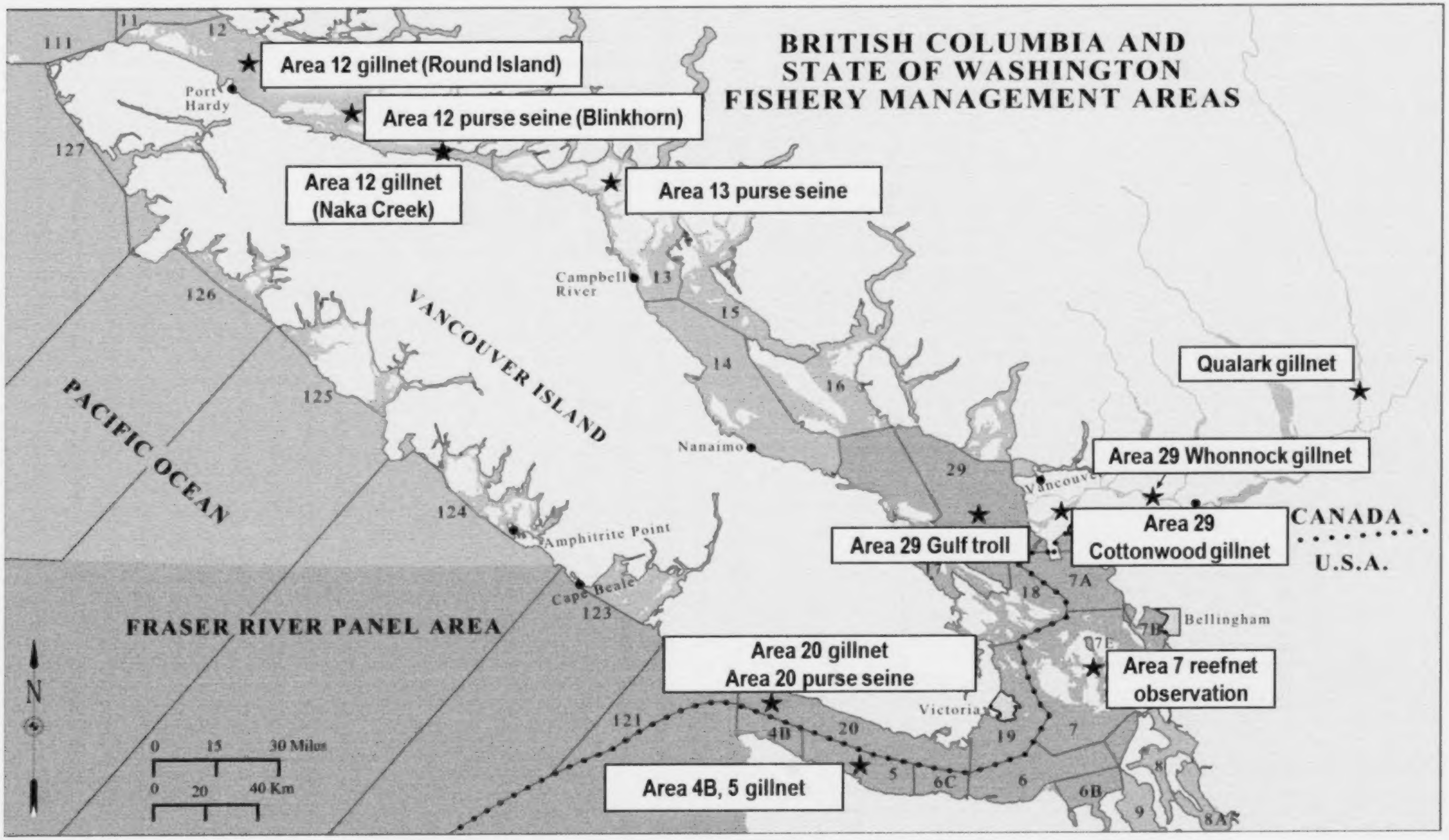
BRITISH COLUMBIA AND
STATE OF WASHINGTON
FISHERY MANAGEMENT AREAS
Area 12 gillnet (Round Island)
Area 12 purse seine (Blinkhorn)
Area 12 gillnet
(Naka Creek)
Area 13 purse seine
Qualark gillnet
Area 29 Whonnock gillnet
Area 29 Gulf troll
Area 29
Cottonwood gillnet
Area 20 gillnet
Area 20 purse seine
Area 7 reefnet
observation
Area 4B, 5 gillnet
Port Hardy
Campbell River
Nanaimo
Vancouver
Amphitrite Point
Cape Beale
Victoria
Bellingham
VANCOUVER ISLAND
PACIFIC OCEAN
FRASER RIVER PANEL AREA
CANADA
U.S.A.
N
0 15 30 Miles
0 20 40 Km
111
11
12
127
126
125
124
123
121
13
15
14
16
29
17
18
7A
7B
7E
7
19
20
4B
5
6C
6
6B
8
8A
9

Figure 1: Map of current Fraser River test fisheries.

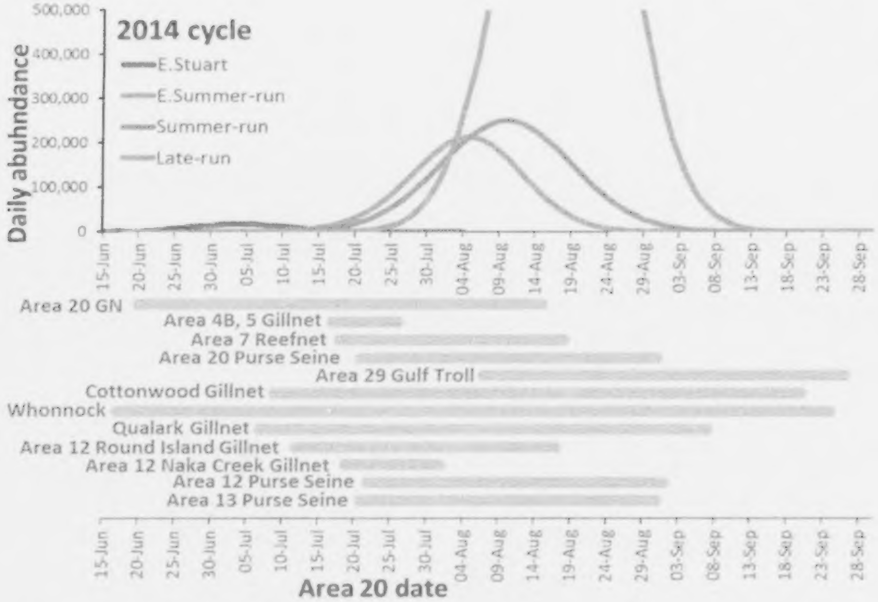

Figure 2: Example of the historic test fisheries schedule for the 2014 season, a year with high salmon abundance.

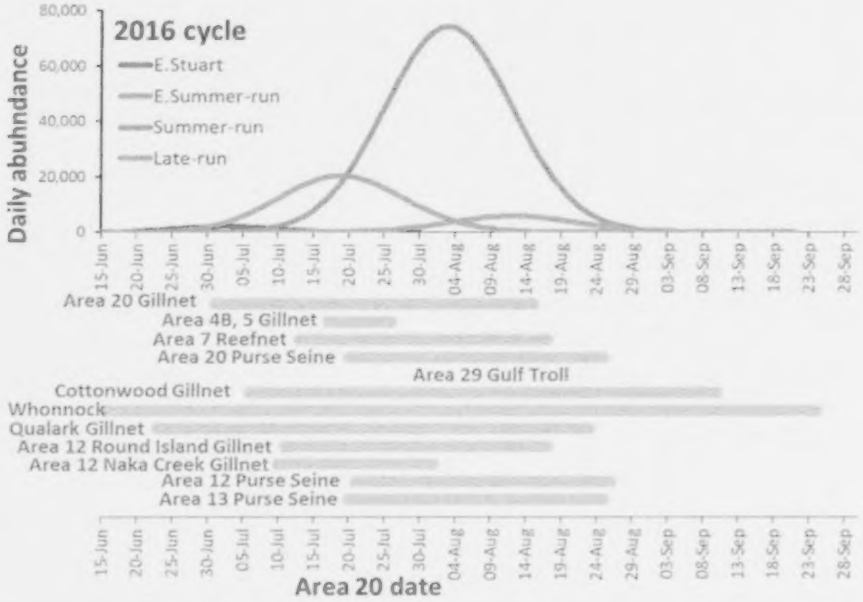

Figure 3: Example of the historic test fisheries schedule for the 2016 season, a year with low salmon abundance.

1.2 Context, Purpose, and Scope of this Review

There are various drivers that served as a motivation for this review. Concerns have been raised on a regular basis during in-season management about various aspects of available test fishing data and potential for use of other information in decision making by the Panel. Specific questions voiced were in regard to potential biases and limitations in data from test fisheries, challenges with some specific test fisheries, ongoing interest in other types of information that could be used to inform decision making, and inevitable changes over time that can affect their performance and the ability for in-season run size models to adequately predict run size.

More recently, poor returns of both sockeye and pink salmon have elevated the importance of ensuring that individual test fishing program elements are justifiable both in terms of their total fishing mortality and cost-effectiveness. To that end, there is a desire to limit the amount of fishing mortality associated with test fisheries to maximize the number of fish available to meet domestic and international catch objectives identified in the Treaty while achieving escapement needs and ensuring the robustness of test fishery assessments. These small returns have also generated greater scrutiny over the number of fish (pay-fish) taken in addition those unavoidably killed in the conduct of test fishing operations or required for biological samples. In response, test fisheries and the total retention of sockeye and pink salmon has been minimized in recent years. This action presents two challenges for the Panel; revenue from test fishing program is insufficient to be self-sustaining, and concerns with rigor of in-season assessment used in managing fisheries. With regard to the revenue element of the challenges faced by the Panel, low returns during 2015, 2016, and 2017 coupled with reduced test fishing programs resulted, in test fishery program costs exceeding revenue by hundreds of thousands of dollars each year. Fortunately, these costs have been covered by the countries through special contributions to the test fishing revolving fund in recent year. With the likelihood of securing long-term funding for the test fisheries program uncertain, the Panel felt it prudent to prioritize exploration of opportunities to reduce costs. The Panel also felt it was important to assess the implications of reducing the test fishing program. There is also a concurrent review of Fraser River hydro-acoustics underway, and there are benefits in reviewing test fisheries at the same time since these two monitoring components comprise the key elements of the Fraser River sockeye and pink salmon assessment program.

The purpose of this review was to identify opportunities for refining / improving the test fishery program to ensure it provides high quality information that can inform the Fraser River Panel in making decisions regarding management of Fraser River sockeye and pink salmon. This review focused on providing a technical assessment of Fraser River Panel related test fisheries in freshwater and marine environments within Canadian and United States waters. The intent was to use a consistent set of criteria to compare the strengths / limitations of any potential refinements to the program and provide information about the relative merits of alternative methods for collecting key information (i.e., different sources or technologies). This review did not involve an exploration of different policies, such as alternative administrative / funding arrangements between the two countries to support the operation of these test fisheries. The intent was that the key findings from this review would be used by the Fraser River Panel to develop recommendations and identify next steps to be considered by the Commission who will ultimately make decisions regarding the future of the test fisheries program.

2 Review Process

This review involved compiling existing information around historic / existing test fisheries, gathering technical input from a variety of government and stakeholder interests in both Canada and the United States, and conducting technical analyses to provide answers to some critical questions that could be addressed in the timeframe for this project with readily available data. The review had four specific components:

- **Component 1**: The project began with a review and synthesis of existing information and past studies related to Fraser River test fisheries. An evaluation framework was also developed to provide a consistent and transparent approach to evaluating potential refinements to existing test fisheries, informed by the critical performance considerations of scientists and decision makers (see below). An engagement template was developed and distributed to participants invited to the first workshop to gather their input and develop a broader perspective about potential refinements to test fisheries in advance of this workshop.
- **Component 2:** A first 2-day workshop was convened on November 2nd and 3rd, 2016 involving 36 participants. The objectives of this workshop were to:
  - Develop a common understanding of existing test fisheries with identification of strengths / limitations with the current program;
  - Confirm performance criteria for comparing strengths and limitations of test fishery options;
  - Identify options for test fisheries / data that could be used to replace or add to the information that is currently collected; and
  - Gather input on next steps to further evaluate these options after the workshop.
- **Component 3:** Building on the outputs and identified needs from the first workshop, a set of targeted technical analyses and research activities were undertaken by this report's authors to provide answers to questions that could be addressed with readily available information / data.
- **Component 4:** A second 2-day workshop was convened on May 31 and June 1, 2017 involving 31 participants. The objectives of this workshop were to:
  - Review reflections that emerged from workshop #1;
  - Review findings from priority research activities completed since workshop #1;
  - Develop suggestions on how current test fishery program could be refined based on key performance criteria; and
  - Gather input on immediate, near term, and longer term needs to inform future decisions about possible refinements to the current test fishery program.

A summary of the critical outputs from the main components of work are provided in Section 3. This project was mostly completed between the summer of 2016 and the fall of 2017, spanning two fiscal years of the Southern Endowment Fund. Activities were led and completed by the report authors. Guidance and review was provided by an advisory committee with additional input provided by workshop participants. The advisory committee and workshop participants included scientists, decision makers, members of First Nations and Tribal organizations / governments, as well as stakeholders from both Canada and the United States, including several members of the Fraser River Panel and Technical Committee (see the Acknowledgements section).

Changes to test fishery operations have been proposed over many years by different audiences to improve some aspects of the test fisheries program. Each refinement has different strengths and/or weaknesses, and a decision to implement a particular change requires a consideration of the trade-offs among competing factors. For instance, a change to the test fishery program might be appealing if it reduces costs, but might also be inappropriate if it affects the timeliness or quality of information being provided to decision makers. This review process was designed to provide a consistent and transparent framework for evaluating potential changes, by using a common and specific set of performance criteria that relate to the fundamental issues that matter to scientists, stakeholders, and decision makers. The performance criteria were then used to facilitate discussions around trade-offs in relation to the proposed changes. The performance criteria that formed the basis of the evaluation framework are summarized in Table 3.

Table 3: Summary of performance criteria that formed the basis for evaluating potential refinements to current test fisheries.

Performance criteria	Description
Value / relevance of the information to Fraser River Panel management decisions	Information from test fisheries may: (1) be directly used to inform run size assessment and timing and the Panel's decisions to achieve PST Chapter 4 objectives, (2) be of use to the Panel but not directly relied upon to inform bilateral management decisions, (3) not be used by the Panel but is useful outside of the Panel's process, and (4) only be needed under certain circumstances or for certain non-Panel audiences. It is important to understand the relevance of the information for these different purposes / audiences.
a. Type of information	Scientists and decision makers need specific types of information from test fisheries. This criterion clarifies the type of information being provided and how it aligns with the needs of the assessment program, specifically related to, (1) abundance, timing, diversion rate, and delay, (2) stock ID/composition, (3) species composition, (4) spatial distribution, (5) vulnerability, and (6) catchability.
b. Timeliness of information	Having timely information is critical for in-season decision making. This criterion provides a consideration of the timing around when the information would be provided and whether there would be any changes relative to the status quo (i.e., increases or decreases in timeliness relative to a reference point such as Mission hydro-acoustics, for instance).
c. Quality of information	The in-season stock assessment process seeks to provide high quality information which is defined by the accuracy and precision of abundance and timing estimates of salmon migration.
Financial	
a. Cost to implement	Some test fisheries or technologies may have impacts on the direct costs of gathering the necessary information / data separately from impacts on revenue from sample fish. It is important to understand these changes when evaluating potential refinements.
b. Revenue from sample fish	Test fisheries provide an important source of revenue to help cover the costs of operating the test fisheries program. As such, it is worthwhile evaluating whether a potential refinement has the potential to increase or decrease revenues from sampled fish.
Fish mortality	
a. Target species	Alternative test fisheries and technologies can have impacts stocks of target species (i.e., sockeye and pink), which would affect the potential uses and harvest of others. For these reasons it is important to understand the implications of a potential refinement on target species (i.e., implied increase or decrease impact on fish mortality).
b. Non-target species	Mortality of non-target species, such as coho and Chinook, may also be affected by test fisheries; an important consideration when evaluating potential refinements to the current test fisheries program.

3 Key Findings

3.1 Critical Outputs from Workshop #1

A list of participants, the agenda, and proceedings from the first workshop are provided in Attachment B. A summary of all potential refinements to the test fisheries (TFs) program that emerged from plenary and sub-group discussions at this workshop is provided in Attachment C. A critical output from this meeting was a list of priority activities to explore with additional research and technical analyses. There was general agreement among participants that these activities were the most important to help stakeholders and decisions makers assess the potential merits of the most promising refinements to the current test fisheries program and thereby address the core needs of the program. These priority activities included the following[4]:

1. *Developing decision rules and/or heuristics to guide pre-season planning and in-season deployment of test fisheries under different scenarios and conditions*. Although there is no shortage of pre-season planning, current implementation constraints have limited in-season modifications to small changes to pre-season schedules (e.g. delaying starts or stopping a few days earlier than planned) Developing a more explicit and systematic rationale would allow the use of proactive deployment and deactivation rules based upon the anticipated conditions in a particular year. These types of decision rules would improve the clarity and transparency of decisions related to test fishery deployment. Ideally, such a task would involve identifying the specific set of decision criteria, such as salmon abundance, TAC, timing of TFs relative to peak abundance, and confidence in abundance estimates, that best align with a particular spatial and temporal pattern of deployment of test fisheries.
2. ***Reviewing existing test fisheries to better understand their relative value and non-Panel uses / benefits.*** It was recognized that existing test fisheries provide value by serving a variety of uses to different audiences beyond the Fraser River Panel. There is a lack of information / synthesis about these other uses and potential benefits to inform decisions about potential refinements.
3. *Developing a strategy for systematically managing other sources of information and data relevant to in-season fisheries management.*[5] Many recognize that other sources of information are available, such as data from Food, Social, and Ceremonial (FSC) fisheries, as well as commercial fisheries when there is TAC. These sources could be useful for informing in-season fisheries management decisions. There is, however, no systematic approach for gathering, managing, using, or evaluating the value of these data for in-season purposes. Having established methodologies and a strategy in place would be helpful for enabling their application.

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[4] After the workshop these nine activities were prioritized further with the advisory committee to identify research tasks that could realistically be completed between the first workshop in the fall of 2016 and the second workshop in the spring of 2017. Five of these activities (identified in bold: #2, 4, 5, 6, and 7) formed the basis for framing the research activities described in Section 3.2.

[5] Although activity #3 was not identified as a priority activity to address between workshops 1 and 2, it is viewed as a critical next step toward ensuring that such information is consistently evaluated and incorporated.

4. ***Improving timeliness of in-season information by the use of data from fisheries more seaward than current configuration.*** Having more seaward information would help in the timeliness of decisions about fisheries openings. Existing seaward data were readily available for this review (e.g., data from District 104, Area 2W, Gordon Group) and could be explored to examine whether there are relationships between seaward CPUE and Fraser CPUE, and value in gathering more seaward data in the future.

5. ***Evaluating alternative configurations of test fisheries in Johnstone Strait.*** There are some potential redundancies and alternative configurations for collecting data in the Johnstone Strait area (e.g., Round Island and Naka Creek). An exploration of alternative configurations would help inform discussions to understand if the current configuration of test fisheries can be improved.

6. ***Evaluating representativeness of purse seine test fisheries in Areas 12 and 13.*** There is the potential for refinements in the set locations of these purse seine test fisheries. Additionally, commercial ITQ purse seine test fisheries occur in this area which might be useful in years when commercial fisheries occur. An assessment of improvements to in-season estimates as a result of alternative set locations and data sources would be informative for understanding the benefits of potential refinements.

7. ***Reviewing and refining the current suite of in-river test fisheries.*** A combination of in-river gill net test fisheries is operated in the lower Fraser River (Cottonwood, Whonnock, and Albion). Although these in-river test fisheries serve a mix of needs for different salmon species, there may be an opportunity through changes to operations of these test fisheries to reduce costs.

8. *Evaluating the feasibility of alternative technologies for estimating in-season abundance in the marine environment.* There was interest in exploring the feasibility of deploying hydro-acoustics technologies in the marine environment as an earlier supplement to information provided by the Mission hydro-acoustics program. There could be the possibility of deploying this technology either as boat-mounted side-scanning sonar or at a fixed location along the salmon migration routes.

9. *Improving the understanding of holding patterns of late-run sockeye and pink salmon in the Strait of Georgia.* The Area 29 gulf troll test fishery currently provides information about the holding patterns of late run sockeye, yet there are some research studies investigating whether alternative technologies (i.e., tagging / telemetry studies) could improve the quality of the data.

3.2 Summary of Research Activities

Five priority activities identified at the first workshop were followed up on with additional technical analysis to evaluate the advantages and disadvantages of making changes to the current test fisheries program. An overview of those analyses is provided here, organized by activity numbers from Section 3.1 and research questions that were addressed. An overview of the results from these research activities is provided in Attachment D, with full summaries of the data, methods, and results provided in Attachment E.

3.2.1 Reviewing existing test fisheries to better understand their relative value and non-Panel uses / benefits

Problem context:

Test fisheries data are essential for in-season assessment and decision making needs, but are also used to generate a variety of other products. Test fisheries data and related products also serve a variety of uses for different audiences beyond the Panel. There is a lack of information about these other uses and potential benefits. The intent with this activity was to understand and summarize the ways in which test fisheries data are used by different user groups. We deployed an online survey of a cross-section of users experienced with the test fishery program to gather a better understanding of alternative uses of test fisheries data. The survey focused on gathering a breadth of information – it was high-level, relatively short, and distributed to 50 people.

Activity #2: How do various groups use the test fishery data for other purposes outside the primary, Panel-agreed purposes and functions of the test fishery program?

Key findings:

Use of PSC Information Products[6]: These products are widely used and most respondents use three or more of them (20 respondents use 3+). A few people only use the data products. Web traffic data was only available from September (due to a website upgrade); the most popular downloads were the daily test fishery results (1491), Whonnock GN (1106), and the annual test fishery summary (569).

Use of Data from Test Fisheries: The number of respondents that use data directly from an individual test fishery ranged from 3 (Gulf Troll) to 15 (Area 20 GN), out of the 20 that use these data (Figure 4). The data are predominately used for in-season purposes, while many respondents also use data from an individual test fishery post-season. Respondents reported using the catch and effort data from all twelve test fisheries with variation in terms of their usefulness for representing catch of different species (Table 4).

Many of the responses and comments regarding use of these data confirmed the Panel-agreed purposes and functions of the program (e.g., the need to understand stock size and timing to inform management decisions) and the contribution of individual test fisheries to the estimation of aggregate characteristics (e.g., abundance, timing, spread, and diversion of run by management group). Respondents further indicated how certain test fisheries are useful for providing: (1) qualitative indicators or presence and/or movement through certain areas, (2) confirmation or verification of other test fishery results, (3) delay behaviour of late run fish, (4) biometrics information on sampled fish, and (5) verification of expansion lines. These uses are essentially established aspects of the test fishery program and thus do not constitute other, alternative uses *outside* of the program.

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[6] This includes: daily test fishing reports; Fraser River Panel weekly reports; Fraser River Panel regulatory announcements; Sockeye and Pink salmon in-season status reports; and, Fraser River Mission escapement reports.

Table 4 summarizes ways in which the data from the test fisheries are being used that could be considered as "other" or "alternative" ways in which the data from individual test fisheries are being used (though columns A and B are implicitly part of the program). Column A indicates the places where respondents stated that the data from an individual TF were useful to them because they helped "manage expectations" or "give indications" about potential fishery openings that might occur.[7] However, respondents did not provide further information on exactly how they use these data to set and/or manage their expectations. Column B represents cases where respondents indicated that the data from the test fishery are useful for providing information relevant to a fishery that is actually open. One respondent indicated that both the Area 20 gillnet and Area 12 Round Island gillnet test fisheries "help with decisions on focusing one's fishing effort". Two other respondents said that data from the Area 20 test fishery are used to estimate catch in commercial fisheries (when scheduled) and data from the Area 7 reefnet test fishery "allow an approximation of potential US catches in Area 7/7a fisheries".

Implications of refinements to test fishery program:

When considering potential modifications to the existing test fishery program, it is important to understand where data are being used for other, alternative purposes outside of the Panel-agreed purposes. Even if these additional, external benefits are not explicitly incorporated into Panel decisions about the structure of the program, it is valuable to understand the broader suite of benefits to fully understand consequence of any changes to the program.

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[7] If survey respondents did not explicitly state that a particular TF is useful for managing Pink salmon fisheries, then only Sockeye fisheries are noted. However, just because no respondent mentioned it does not mean that a particular TF is not potentially useful for managing expectations about Pink salmon fisheries as well.

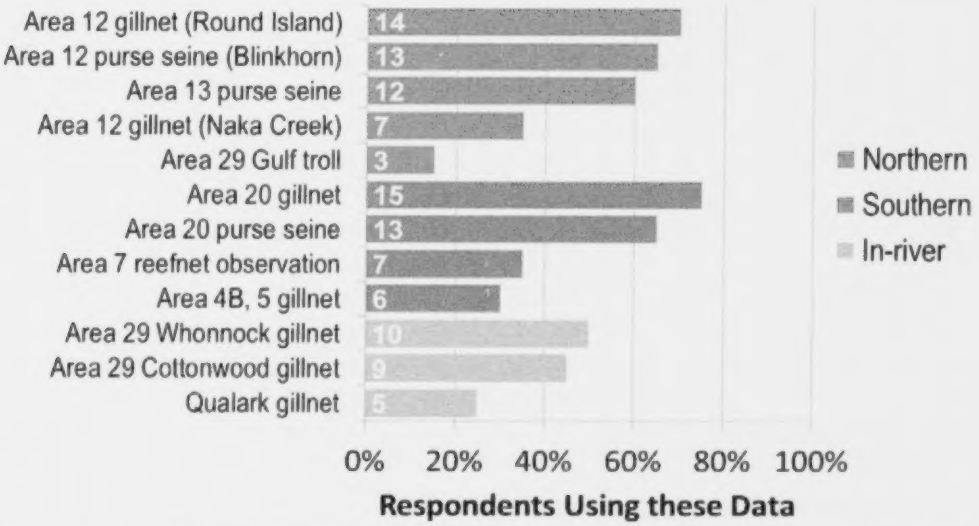

Figure 4: List of the current suite of test fisheries and proportion of respondents who noted use of the resulting data / information. Note that the PSC secretariat's in-season assessment program does not use data from the Area 12 (Naka Creek), Area 7 reefnet observations, Area 4B, 5 or Qualark test fisheries.

Table 4: Summary of other uses of data from current test fisheries.

		(A) Informing Expectations for Potential Fisheries	(B) Information of Direct Use for Scheduled Fisheries	(C) Using catch & CPUE for other salmon species			
				Chinook	Coho	Chum	Hood Canal Chum
1	Area 20 Gillnet	SK/Pink	X				X
2	Area 20 Purse Seine	SK/Pink					X
3	Area 12 Gillnet Round Island	SK	X		X	X	
4	Area 12 Purse Seine Blinkhorn	SK		X	X	X	
5	Area 13 Purse Seine	SK		X	X	X	X
6	Area 29 Cottonwood Gillnet	SK/Pink					
7	Area 29 Whonnock Gillnet	SK/Pink					
8	Area 29 Gulf Troll						
9	Area 12 Gillnet Naka Creek	SK					
10	Area 4B, 5 Gillnet	SK/Pink					
11	Area 7 Reefnet Observation	SK/Pink	X				
12	Qualark Gillnet	SK/Pink		X	X	X	

3.2.2 Improving timeliness of in-season information by the use of data from fisheries more seaward than current configuration

Problem context:

Fisheries that are more seaward of current test fisheries have the potential to provide more timely information on the size and timing of Fraser sockeye returns than existing test fisheries. Three potential data sources have been identified which could provide valuable insights into whether there is value in collecting more seaward information:

- District 104 (D104) purse seine fisheries at Noyes Island in Southeast Alaska
- Troll fisheries in Area 2W (West Coast Haida Gwaii)
- Fisheries data from the Gordon Group (i.e., a purse seine test fishery operated in 2005 and 2006, as well as a smaller scale FSC fishery in 2003 and 2004)

Separately from a consideration of these data sources, it is also worth evaluating the potential benefits of having data that is the same quality as hydro-acoustics data available sooner than is currently the case to better understand the value of more seaward information.

This activity involved using the above data sources to quantitatively evaluate if seaward information can improve in-season assessments of run size and timing of Fraser River sockeye returns.

Activity #4A: Do Southeast Alaska District 104 and Area 2W fisheries inform in-season estimates of Fraser sockeye run size and run-timing?

Key findings:

District 104:

- D104 Fraser sockeye timing is not correlated with Area 13 and 20 timing. Though there are some years where D104 timing is earlier than Area 13 and 20 timing (e.g., by 1-2 weeks) there are many other years where it is the same or even later.
- D104 CPUE is not correlated with Fraser run size.

Area 2W:

- While Area 2W catch and timing may be related to actual run timing in some years, there is a strong tendency for peak catches in northern areas to be of fish which are later than the peak of the run on the south coast (PSC 1997).

Implications of refinements to test fishery program:

The lack of a relationship between the timing and abundance of Fraser sockeye observed in D104 and on the south coast of British Columbia suggests that existing information on Fraser sockeye run-timing and abundance from District 104 is not expected to help inform in-season assessment of Fraser sockeye run-timing and size moving forward. If marine water temperatures continue to increase in future years Fraser sockeye may demonstrate a more northerly landfall which could change this relationship.

Given that: (1) the qualitative patterns observed for D104 appear to also hold for the Area 2W fishery (PSC 1997); (2) the Area 2W troll fishery has not operated in recent years on sockeye; and (3) there is unlikely to be an Area 2W troll sockeye fishery in years to come, information on Fraser sockeye from Area 2W is also not expected to help inform in-season assessment of Fraser sockeye run-timing and size in the future. Here again, if marine water temperatures increase in future years, relationships may be developed in the future if fishing and migratory pattern change over time.

Activity #4B: Can a Gordon Group purse seine test fishery inform in-season estimates of Fraser sockeye run-timing and size?

Key findings:

- Gordon Group test fishery CPUE loosely tracks Areas 12 CPUE suggesting that it could potentially inform fishery planning in Area 12 by providing an early qualitative indication of whether daily abundance is increasing or decreasing.
- On average, the catchability at the Gordon Group site is lower than at the current Area 12 purse seine test fishery locations, resulting in lower CPUE (i.e., ~1/3 of Area 12 test fishery CPUE).
- Using Gordon Group CPUE data to quantitatively predict abundances generates more biased and less precise in-season estimates than Area 12 test fishery data. However, the Gordon Group test fishery does so 2 days earlier.
- Catchability at the Gordon Group site was slightly higher when estimated from the FSC fishery data compared to the test fishery at the Gordon Group (0.5 vs. 0.33), but still lower than at the current Area 12 purse seine test fishery locations.
- Using the Gordon Group FSC CPUE data to quantitatively predict abundances generated more biased and similarly precise in-season estimates compared to those from Area 12 test fisheries in 2003, and more biased and less precise in-season estimates in 2004.
- The above findings were qualitatively unchanged when the Early Summer run was considered instead of the Summer-run.

Implications of refinements to test fishery program:

The available data suggest that Gordon Group CPUE provides a weak qualitative indication of the abundance of sockeye that are potentially available for fisheries in Area 12 two days later.

The Gordon Group has the potential to provide quantitative in-season estimates of daily abundance approximately 2-days earlier than the current Areas 12 test fishery. However, these estimates are predicted to be more biased (negative) and less precise than in-season estimates derived from Area 12 test fishery CPUE. The potential benefits of earlier information for in-season run-size estimates from the Gordon Group are predicted to be negligible as it has been shown that the majority of the time in-season run-size estimates are not predicted to improve when using seaward CPUE data like those that could be collected in the Gordon Group (see Activity #4C).

Activity #4C: Can the use of seaward information improve quantitative in-season run size assessments or provide useful timing information?

Key findings:

- Seaward information can be quantitatively included in the current assessment methodology by incorporating the information in the prior probability distribution for run size or timing or by fitting the in-season run-size model to the additional time series.
- Improving the quality of the data (using seaward echo-sounding) or the timeliness of the data (using seaward test fisheries) can only improve run-size estimates to a certain extent. The performance of the run-size model will depend to a larger extent on how well the model is able to predict abundances seaward of the test fisheries.

Using seaward data or timing estimates for earlier-timed stocks to update the run-timing prior:

- Based on the precision of the estimates, the preseason timing forecast is a better predictor of the timing of the run than the timing of non-Fraser stocks (Figure 5A) or the timing obtained from seaward information such as District 104 catches (see Activity #4A). The timing of earlier-timed Early Stuart is a better in-season predictor of the timing compared to the pre-season forecast (Figure 5A).
- When running the in-season run size assessment model 3 days after the peak of the run, the last 6 days of test fishery data provide sufficient information about the peak of the run to update the prior distribution on timing and decrease the uncertainty in the timing estimate (Figure 5B).

Using seaward hydro-acoustic data for run size estimation:

- At the peak of the run (with hydro-acoustic data and echo-sounding data available up to the day before the peak of the run), there is no improvement in the median run size estimate using seaward echo-sounding data (Figure 6A).
- Three days after the peak of the run, using seaward echo-sounding data instead of test fishery data would improve the accuracy of run size estimates by 10% (median) while after 6 days the improvement is reduced to 5% (median, Figure 6A).
- Using hydro-acoustic data instead of test fishery data decreases the uncertainty around the run size estimates (relative inter-quartile range, IQR) (Figure 6B).

Using seaward CPUE data for run size estimation:

- For the majority of the years, in-season run-size estimates do not improve when using seaward CPUE data. Test fishery data seaward of the current test fishery data is only useful (> 10% improvement in run size error) at the peak and 3 days after the peak of the run for 16% of all years (Figure 7A), when the run size uncertainty is very large (Figure 7B).
- For run-size assessments, the main benefit of collecting data at locations seaward of the marine test fisheries does not lie in the 2 additional days of CPUE data but in the collection of an additional independent CPUE time series to improve daily abundance estimates seaward of Mission. But, an independent time series of CPUE in Johnstone Strait could be better collected in Area 13 than seaward of Area 12.

Implications of refinements to test fishery program:

Using seaward data or timing estimates for earlier-timed stocks to update the run-timing prior:

- Because some seaward information is collected for different purposes, these data may not be available on time to be useful for in-season assessments.
- In addition, in-season fisheries-specific stock ID information is needed to improve the usefulness of the seaward information for run size assessment.

Using seaward hydro-acoustic data:

- The value of seaward echo-sounding data for run-size assessment will likely be smaller than indicated by the retrospective analysis, given the larger sampling area and the limited ability to control the sampling environment. Species identification problems may further reduce the accuracy of derived salmon abundance estimates.
- Abundance estimates derived through echo-sounding at Chatham point would only cover part of the run unless similar sampling would take place in Juan de Fuca Strait, and there could be concerns regarding acoustic disturbance of both resident and Bigg's (transient) killer whales.
- Marine echo-sounding cannot completely replace test fishing as test fishing catches are needed to obtain stock ID information. Low gillnet catchability later in the season may necessitate more expensive purse seine test fisheries to achieve sample sizes.
- Substantial research and development costs are associated with implementing a seaward assessment strategy.

Using seaward CPUE data:

- The value of seaward CPUE data for run-size assessment will likely be smaller than indicated by the retrospective analysis, because the seaward CPUE data are likely less precise due to the wider sampling area. Lack of stock ID information from seaward test fishing catches would further decrease the value of the seaward data.
- If the catchability of the seaward test fishery differs from Area 12 (as suggested in Activity #4B), data need to be collected to estimate the catchability or assumptions need to be made based on the width of the migration area.
- A second independent time series of CPUE data in Areas 12 or 13 benefits run size estimation more than seaward assessment (see Section 3.2.3, Activity #5B).

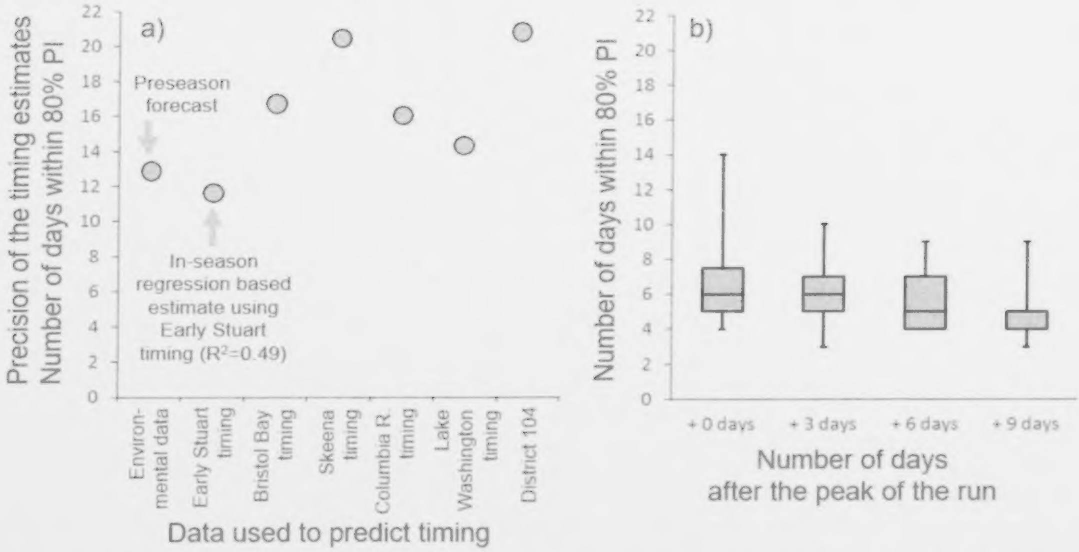

Figure 5: Precision of the predicted timing estimates for Summer-run sockeye stocks excluding the Harrison River (expressed in terms of the number of days covered by the 80% probability interval). (A) The pre-season forecast relies on environmental data to predict the timing while the in-season forecast relies on the in-season estimate of timing for earlier timed Early Stuart stock group. The resulting timing predictions can be compared against timing predictions using earlier timed non-Fraser stocks (Bristol Bay, Skeena R., Columbia R., Lake Washington, etc.) or seaward data from Fraser River stocks (District 104 CPUE). (B) In-season timing estimate using the run size model fitted to reconstructed abundance and purse seine test fishery CPUE data for Summer-run sockeye stocks excluding Harrison River.

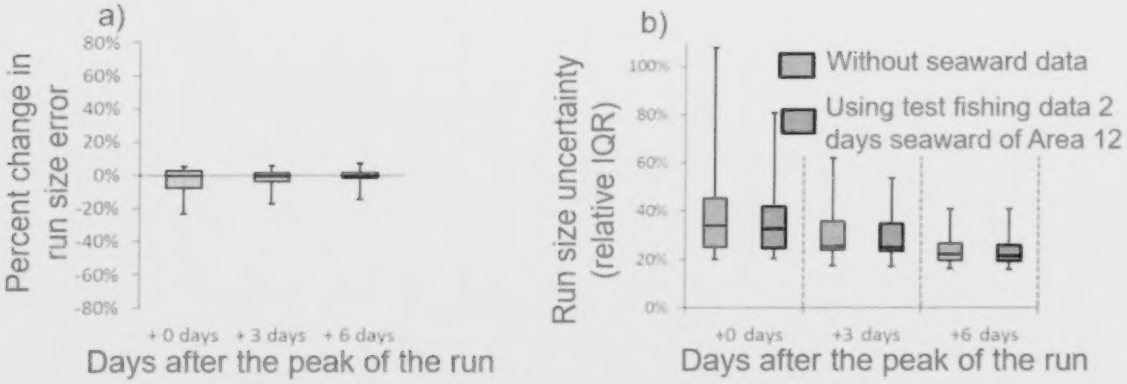

Figure 6: (A) Percent change in run size error at different times during the season (at the peak of the run and 3 or 6 days later), using two additional days of seaward test fishery data versus without such data, and (B) comparison of the run size uncertainty with or without the use of two additional days of seaward test fishery data at different times during the season.

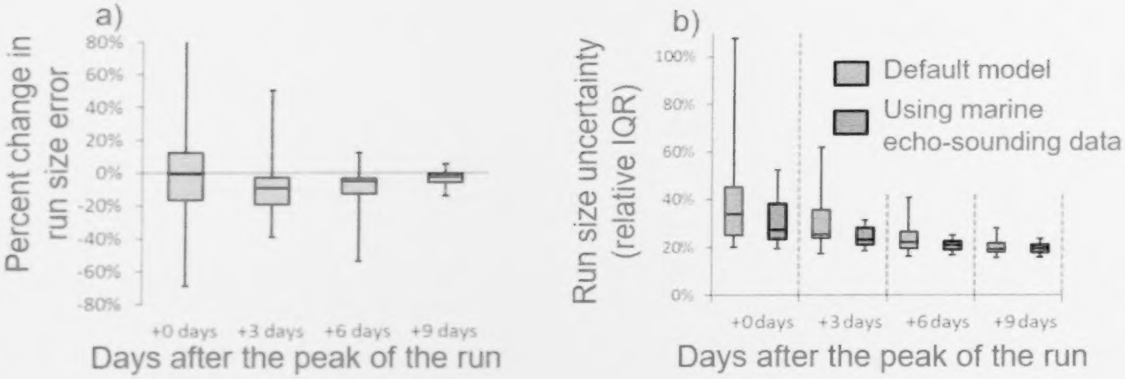

Figure 7: (A) Percent change in run size error at different times during the season (at the peak of the run and 3, 6 or 9 days later), using seaward hydro-acoustic data versus without such data, and (B) comparison of the run size uncertainty with or without the use of seaward hydro-acoustic data at different times during the season.

3.2.3 Evaluating alternative configurations of test fisheries in Johnstone Strait

Problem context:

There are several test fisheries that operate in Johnstone Strait and it has been suggested that their configurations could be adjusted to improve the overall efficiency of the program. The Naka Creek gillnet test fishery was conducted for 10 – 12 days per year from 2009 to 2015. Part of the rationale for the Naka Creek test fishery was to have a gillnet test fishery in a lower portion of Johnstone Strait than the Round Island location that could improve assessment of Early Summer run sockeye. Even though this test fishery is one day less seaward than the Area 12 test fishery, the narrower width of the Strait at this test location improves the catchability of fish. It has been suggested that the potential benefits of using CPUE data from this test fishery to improve in-season assessment of daily abundance and run size should be quantified. This activity quantitatively evaluated the merits of alternative potential configurations and data sources for a subset of fisheries data from the Johnstone Strait.

Activity #5A: Can data from the Naka Creek gillnet fishery improve in-season estimates of Fraser sockeye abundance and run-size?

Key findings:

- Naka Creek CPUE was not correlated with Round Island CPUE, however, the CPUE at Naka Creek was generally higher than at Round Island. The median ratio of Naka Creek versus Round Island was 3.5, indicating that Naka Creek catches 3.5 time more sockeye per unit effort, though there was a lot of variability among years.

- Marine abundance estimates based on the combination of Round Island and Area 20 CPUE data were more strongly correlated with reconstructed marine abundance estimates than the combination of Naka Creek and Area 20 CPUE data for the same days.
- Round Island produced unbiased predictions of in-season abundance, while the average bias using Naka Creek data was 8%. Using Naka Creek data in combination with Round Island reduced the average bias to 4%.
- When using in-season catchability estimates, Naka Creek generated abundance estimates with higher precision than when using Round Island (4% difference in precision error) or both data sets combined but the benefit of increased precision would be offset by the higher bias when using Naka Creek CPUE.

Implications of refinements to test fishery program:

- Given the higher CPUE at Naka Creek than Round Island, CPUE from Naka Creek would be a better indicator of expected commercial catches in that area (assuming the commercial fisheries were occurring closer to Naka Creek). In addition, adding Naka Creek to the current suite of test fisheries would increase the sample size for stock ID in Area 12 during low abundance years, though the representativeness of the samples taken for stock ID at Naka Creek would need to be compared against samples from other test fisheries in the area (e.g. Round Island, Area 12 purse seine).
- Because the CPUE at Naka Creek is not correlated with the CPUE at Round Island and because differences in catchability between the two sites vary substantially from year to year, it is difficult to use historic catchability based on Round Island data in combination with the Naka Creek data to estimate daily abundance.
- Integrating Naka Creek data within the current run size assessment models is possible but would result in little or no improvement in abundance estimates, and seems insufficient to warrant the additional cost of operating the Naka Creek test fishery on a daily basis in future years.
- A Naka Creek specific catchability estimate would be needed to thoroughly evaluate replacing the Round Island test fishery with the Naka Creek test fishery. The Naka Creek test fishery would therefore need to be run for the full gillnet test fishing period for several years in order to have comparable data available for both sites.
- Logistical issues at Naka Creek, including lack of cell phone communication and remote location, make it difficult to deliver the required DNA and scale samples in a timely manner.

Activity #5B: Does the use of Area 13 purse seine test fishery data improve in-season estimates of daily abundance and run size?

Key findings:

- Unlike the daily abundance estimates derived from individual boats in Area 20 (see Section 3.2.4, Activity #6C), the daily abundance estimates derived from the Area 13/20 CPUE data can differ substantially from the daily abundance estimates derived from the Area 12/20 data.
- For Summer-run stocks, using Area 13/20 data to estimate daily abundances instead of Area 12/20 does not impact the precision of the daily abundance estimates but increases the biases

in the daily abundance estimates on average by 3%. If the daily abundance estimates from the two data sources are averaged, the correlation between the in-season and post-season daily abundance estimates increases (R^2 becomes 0.5 instead of 0.41). When evaluated over 6 day periods, the correlation between the in-season and post-season daily abundance estimates increases but the impact of including Area 13 diminishes ($R^2=0.68$ for Area 12/20 data and $R^2=0.72$ when averaging abundance estimates derived from Area 12/20 and 13/20 data)

- For Early Summer-run the benefits of using Area 13 when producing daily abundance estimates are not as strong (only 0.02 improvement in R^2) and non-existent when evaluating abundances over 6 day periods.
- Using the data within the in-season run size model, for most years there are limited differences in run size when including Area 13 versus relying on Area 12/20 CPUE data only and the limited differences can signify decreased as well as increased error in the run size (-10 to +10%).
- In some years including Area 13 can substantially decrease run size errors in-season (up to 50%). These improvements mainly occur during years with lower run sizes (<2.5 million), where including Area 13 CPUE data within the model provides a stronger signal that abundances are lower than anticipated, but not all low abundance years benefit from Area 13 data.

Implications of refinements to test fishery program:

- Catches in the Area 13 purse seine test fishery tend to be higher than in Area 12 due to the narrower width of the Strait in Area 13 and as so Area 13 test fishery data may be a better indicator of expected commercial catches in the area than Area 12 test fishery data.
- The Area 13 purse seine test fishery was originally designed to assess Summer- and Late-run migrating sockeye salmon. Averaging the daily abundance estimates derived from Area 13/20 CPUE data with estimates derived from Area 12/20 improves in-season daily abundance estimates but has a lower impact on abundance over 6 day periods. No similar improvements are detected when using Area 13 data for the assessment of Early Summer-run abundance.
- Adding the Area 13 test fishing data within the run-size assessment model is more useful for run-size estimation during low abundance years but this is not necessarily the case for all low abundance years.
- Using uncertain pre-season forecast estimates, it would be difficult to evaluate if Area 13 test fisheries would be useful in a given year, i.e. if the run size is going to be small, especially since its usefulness is associated with confirming indications that run-size estimates may not be as high as expected based on pre-season forecast estimates.

3.2.4 Evaluating representativeness of purse seine test fisheries in Areas 12 and 13

Problem context:

Purse seine test fisheries for Fraser River sockeye currently operate in Areas 12 and 13 from mid-July to late August each year. Approximately 6 assessment sets are conducted on a daily basis at locations within each Area and the average CPUE from these six sets is used in combination with an in-season catchability estimate to produce in-season estimates of daily abundance. The locations of the test fishery sets were originally selected to be representative of the abundance of migrating sockeye in each area. However, a quantitative examination of their representativeness had not been conducted.

It has also been suggested that commercial catch data could be used as an additional source of in-season information to inform Fraser sockeye run size estimates. In 2016, in response to this suggestion, the Southern Endowment Fund supported an exploration of the use of catch information from the Individual Transferable Quota (ITQ) purse seine fishery in Areas 12 and 13 to inform Fraser sockeye run size, which revealed correlations with reconstructed Fraser sockeye abundances that were stronger than the relationships between purse seine test fisheries CPUE and reconstructed abundance (Cave 2017). An evaluation is required to confirm if ITQ CPUE is a better predictor of Area 12 and 13 daily abundances than test fishery CPUE.

Although outside of Areas 12 and 13, there has also been an interest in evaluating the number of boats operating in the Area 20 gill net test fishery. Traditionally, three different boats participated in the Area 20 gillnet test fishery. The Area 20 test fishery operated continuously throughout the season by having two boats fish simultaneously with each boat fishing for 8 days followed by a 4 day break. It has been suggested that the test fishery reduce fishing effort to a single boat per day, however, the consequences of this for estimates of CPUE and resulting abundance predictions are unknown. In addition to the potential uncertainties which could result in assessments, there are safety related benefits in maintaining two gillnet boats in Area 20 because of the geographic location of this test fishery.

Activity #6A: Does an examination of Area 12 and 13 purse seine test fishery set locations reveal opportunities to improve in-season estimates of Fraser sockeye daily abundance?

Key findings:

- In Area 12, two sites (Cracroft Point and Sophia/Splash Island) tend to catch fewer fish (i.e., are biased low) and are more variable (i.e., have lower precision) than other sites, while in Area 13, one site (McMullen Point) tends to catch fewer fish than the other sites and another site (Chatham Point) tends to catch more fish than the other sites. Both sites in Area 13, along with Little Bear, have slightly more variable catches (i.e., have lower precision) than other sites. These sights are open water sets, as opposed to beach set, which may explain why catches are typically lower than at other test fishing set locations.
- In Area 12, the mean daily CPUE is consistently biased low when either Cracroft or Sophia/Splash Island sites are included in the daily estimate of CPUE. But because of the limited number of samples at these locations across the years, the exclusion of these two sites from estimates of daily CPUE does not result in an improved relationship between daily CPUE and abundance.
- In Area 13, the mean daily CPUE is consistently biased when McMullen Point (biased low) and Chatham Point (biased high) are included in the estimate of CPUE, respectively.
- The exclusion of catch from McMullen Point before estimating daily CPUE does not result in an improved relationship between daily CPUE and abundance.
- The exclusion of catch from Chatham Point before estimating daily CPUE results in a slightly weaker relationship between daily CPUE and abundance in a few years.

Implications of refinements to test fishery program:

- Catch from three test fishing set locations in Areas 12 (Sophia/Splash Island and Cracroft Point) and 13 (McMullen Point) appear to not be indicative of the overall abundance of fish migrating through the strait at any given point in time. These locations consistently catch fewer fish than other locations and excluding them from the daily CPUE estimate would improve data quality. However, given the limited number of catch samples taken at these locations compared to the total number of samples, and due to the uncertainty in the corresponding catchability estimate to convert CPUE into daily abundance estimates the improvement in the daily CPUE estimates are insufficient to substantially improve resulting abundance estimates.
- These locations are unique among the commonly used locations because they are on the opposite side of the strait in each Area. They are also all open water sets, in contrast to the remaining locations which are beach sets. While these locations tend to catch fewer fish, they help inform the amount of sockeye migrating through the north (Cracroft Point and Sophia/Splash Island in Area 12) or west (McMullen Point in Area 13) side of the strait.

Activity #6B: Can catch information from commercial ITQ purse seine fisheries improve in-season estimates of Fraser sockeye run size?

Key findings:

Area 12 results:

- The estimated catchability in the ITQ fishery is lower than at the current Area 12 purse seine test fishery locations, resulting in lower CPUE (i.e., ~60% of Area 12 test fishery CPUE).
- Using ITQ CPUE data to quantitatively predict abundances generates similar in-season predictions to those obtained from Area 12 test fishery data in terms of bias and precision. However, in 2014 abundance estimates derived from the ITQ CPUE data less precise than those derived from test fishery data.

Area 13 results:

- The estimated catchability in the ITQ fishery is less than at the current lower Area 13 purse seine test fishery locations, resulting in lower CPUE (i.e., ~80% of Area 13 test fishery CPUE). Using ITQ CPUE data from lower Area 13 to quantitatively predict abundances generates similar in-season predictions compared to lower Area 13 test fishery data.
- In contrast, the estimated catchability in the ITQ fishery is the same as the current upper Area 13 purse seine test fishery locations. But, using upper Area 13 ITQ data generates more biased and less precise in-season predictions than the upper Area 13 test fishery data.

Implications of refinements to test fishery program:

Results from this analysis were consistent with Cave (2017). Because Area 12 and lower Area 13 ITQ catchability is lower than in the test fishery, their consideration as an additional source of information for in-season run size estimation would require a separate catchability estimate to be derived before ITQ data could be used to predict run size in-season (e.g., the Area 12 ITQ data could be converted into an Area 12 test fishery "equivalent" based on the ratio of ITQ to test fishery CPUE).

Once differences in catchability are accounted for, Area 12 and lower Area 13 ITQ CPUE appear to generate Summer-run sockeye abundance predictions that have a generally similar (or improved) magnitude of bias and precision as the existing test fisheries. As a result, ITQ data from these areas warrant consideration as additional sources of information (in addition to test fishery CPUE) for in-season run-size estimation in years when ITQ fisheries occur.

While upper Area 13 ITQ catchability is similar to the Area 13 test fishery, Area 13 ITQ CPUE generates more biased and less precise predictions of Summer-run sockeye abundance than the test fishery. The magnitude of these differences in bias and precision should be taken into account when considering using upper Area 13 ITQ CPUE as an additional source of information (in addition to test fishery CPUE) for in-season run size estimation in years when ITQ fisheries occur.

Full logbook data from the ITQ fishery are not currently available real time in-season. For ITQ catch information to be useful in-season, these data would have to be reported electronically and made available by the end of each fishing day (Cave 2017).

Activity #6C: What is the impact of using one versus two boats in the Area 20 gillnet test fishery?

Key findings:

- Even though CPUE differs between two boats fishing on the same day, CPUE estimates are strongly correlated (R^2=0.69).
- There is no directional bias in CPUE obtained from one boat versus two, but the estimates are not as precise. Overall, the mean absolute percent error (MAPE) in the daily CPUE data is 21%, meaning that the CPUE obtained by one boat will on average differ by 21% from the average CPUE of 2 boats. When evaluating CPUE data over 6 days, the mean absolute percent error decreases to 10%.
- When daily abundance estimates are low (as well as corresponding CPUE estimates), there does not seem to be directional differences between the CPUE of individual fishermen. When daily abundances are high, there may be a directional bias in the CPUE of individual fishermen.
- Very similar daily and total abundance estimates are generated by the CPUE data obtained from individual boats and from both boats combined, however, these abundance estimates may differ substantially from the reconstructed daily abundance based on Mission and seaward catch.
- Inter- and intra-annual variability in catchability has a much bigger impact on the precision of daily abundance estimates than the number of boats used to calculate the average CPUE. The retrospective analysis indicated that while the absolute mean run size error is about 23%, only 4% can be attributed to using 1 versus 2 boats to collect CPUE data.
- The impact of using data from only one boat instead of two decreases as data are pooled over multiple days and the methods used to estimate run-size are designed to be robust to daily CPUE variation by relying on multiple days of data.

Implications of refinements to test fishery program:

Reducing the number of test fishing boats operating each day in Area 20 from two to one results in less precise (and at high abundance biased) estimates of CPUE. This leads to a modest (~4%) increase in in-season run size error. The following points should be also considered when contemplating a reduction in the number of test fishing boats in Area 12:

- Current data used for the analyses is impacted by the interaction between the two boats, as the two boats may assist each other when searching for salmon, covering a wider area of migration.
- If the test fishery schedule was reduced to one boat per night, consideration would have to be given to potential fisherman effect and the spatial pattern of fishing effort.
- Potential safety benefits of having two boats participating to the test fishery at the same time was not evaluated and requires further consideration.
- Having only one vessel may result in days without data or sample sizes that are too low for stock identification, requiring days of data to be pooled.
- Reducing the number of test fishing boats and the number of boat days does not result in a proportional reduction in test fishing costs as the daily charter rate increases with reduced test fishing days.

3.2.5 Reviewing and refining the current suite of in-river test fisheries

Problem context:

It has been suggested that some of the river test fisheries may be removed from the current suite of Fraser River gillnet test fisheries. The pros and cons of dropping and/or reducing one of the current river gillnet test fisheries were evaluated in this section.

Activity #7: What are the advantages and disadvantages of different configurations of the Fraser River gillnet test fisheries?

Key findings:

Each Fraser gillnet test fishery is an integral part of a program and as such is designed with very specific and different objectives in mind. The different programs and test fishery designs have led to differences in the gear used as well as differences in the periods during which the test fisheries are operational. Over the years, a substantial amount of historical data has been accumulated based on a consistent test fishing method that is essential to most programs fulfilling their main objectives. Though potential savings in terms of program costs and fish mortality could be made by eliminating or substantially reducing one or more of the test fisheries, these savings would be offset by mitigative measures required to ensure that the program objectives are maintained (i.e. decreases in one program would require increases in the remaining programs).

Implications on refinements to test fishery program:

The value of information obtained from these test fisheries relates to their varied purposes.

The Cottonwood test fishery uses a variable mesh gillnet (i.e., 4 equal length panels, with each panel utilizing a different mesh-size. The mesh-sizes range from 4¼" to 5¾"). This gillnet was designed to optimize sampling of adult sockeye across their size ranges (i.e. designed to provide a random sample of sockeye salmon). It was designed to accomplish three main goals:

1. Provide an index of abundance and estimate of stock composition in the lower Fraser in advance of future larger scale fisheries (historically commercial, Area E).
2. Provide a sample for estimating stock composition which would include Pitt River sockeye (which are not captured often in other current in-river test fisheries).
3. Provide samples for estimating stock composition for all sockeye stocks expected to migrate upstream in the Fraser River.

The first goal is less critical due to the reduced frequency of larger scale lower river fisheries, however goals 2 and 3 remain critical. Though estimation of Pitt River stock proportions is possible using data from marine gillnet test fisheries (after applying a migration rate assumption), the recent reduction in the Area 20 gillnet test fishery from two boats to one, means that marine samples sizes are reduced and may not be sufficient with the absence of the Cottonwood test fishery. Making additional sets in the other in-river upstream test fisheries to increase the sample size would likely result in minimal cost savings when eliminating or reducing the Cottonwood test fishery and would not provide a sample that includes stocks such as Pitt.

The potential for construction of a new bridge across the Fraser River to replace the Massey Tunnel may have implications on the set location for the Cottonwood test fishery which occurs in the immediate area. In addition the Cottonwood test fishery is conducted in a portion of the Fraser River which would miss fish that migrate up the North Arm of the Fraser River. As such consideration for relocating this test fishery would be warranted.

The Whonnock test fishery uses a variable mesh gillnet (i.e., 7 equal length panels, with each panel utilizing a different mesh-size. The mesh-sizes range from 4" to 8½"). It was designed to accomplish three main goals:

1. Provide an estimate of species proportions that are applied to the Mission acoustics estimates of total salmon to estimate the sockeye migration abundance.
2. Provide samples for stock composition and augment samples from the Cottonwood test fishery. Samples from Cottonwood were used to help estimate Pitt sockeye during the scale-based years by comparing Nadina/Gates/Pitt estimates at Cottonwood (which contained Pitt) to Whonnock (which contained Nadina/Gates only), and in some years, Cottonwood samples were used to determine whether Late-run sockeye were pulsing in and out of the Fraser river with the tide (during these periods estimates of Late-run sockeye proportions are typically higher in samples obtained from Cottonwood than in samples taken at Whonnock).
3. Provide an abundance estimate of sockeye migrating upstream during periods when pink salmon migration predominates in Fraser River (i.e. Whonnock test fishing sockeye CPUE multiplied by an expansion line is used to estimate sockeye abundance instead of the total salmon (from acoustics estimates) multiplied by the Whonnock derived species proportions.

All three goals remain valid today (though it is not needed to help with Pitt estimation now that stock identification is based on genetics).

The Albion test fishery uses three different gillnets:

1. A variable mesh gillnet consisting of 8 panels utilizing 4 different mesh-sizes that range from 6" to 9"). The net is fished every second day from April to September,
2. An 8" chinook gillnet is fished every alternate day from April to October 20
3. A 6¾ "chum gillnet is fished every second day from September 1 to October 20 followed by fishing every day until mid-late November.

CPUE and stock composition information collected during the Chinook period are used to inform Canadian domestic management decisions related to the Chinook chapter of the Pacific Salmon Treaty (PST). CPUE and stock composition information collected during the Chum migration period are used to inform decisions related to the Chum chapter of the PST.

There may be some savings in terms of test fishery program costs and fish mortality (varies by species) associated with alternative combinations of in-river test fisheries (see Attachment E). However, additional costs associated with potential mitigative measures have not been estimated, but would offset potential savings when reducing or combining river test fisheries. In addition, additional calibration studies would need to be conducted prior to substituting test fisheries and a proper calibration would require sufficient years of data during which both the old and new test fishery configuration need to be run simultaneously.

The feasibility of reconfiguring river test fisheries or their operational periods would also include logistical considerations (e.g., mesh sizes, program location and duration) and discussion of potential mitigation measures that would span multiple Chapters of the PST. There would be a need to engage groups beyond the Fraser Panel particularly with respect to the Albion test fishery.

3.3 Critical Outputs from Workshop #2

A list of participants, the agenda, and proceedings from the second workshop are provided in Attachment F. Workshop discussions were heavily informed by key findings from the research and technical analyses summarized in Section 3.2. A summary of all potential refinements to the test fisheries program that remained after a consideration of these findings and discussions to-date is provided in Attachment G. Following sub-group discussions about refinements which might best address different objectives (e.g., maximize value of information, minimize cost, and minimize fish mortality), participants were asked to identify common refinements across sub-groups or remaining information gaps.

The priorities that emerged to further evaluate test fisheries and alternative opportunities to collect adult Fraser Sockeye salmon return abundance, timing and diversion rate assessment information are provided below. These priorities include a mix of activities that remained unresolved after the first workshop and responded to key findings revealed through the additional technical analyses presented at the second workshop. After the workshop these nine activities were prioritized further by the Fraser

River Panel. The five activities in bold (#2, 3, 4, 5, and 9) represent the priorities identified by the Panel for the 2018 Southern Endowment Fund (SEF) call; proposals were submitted to the SEF for all bolded activities, except item 9.

1. *Reduce Area 20 gill net test fisheries from two boats to one.* Based on the findings from technical analyses summarized in Section 3.2.4 (Activity #6C), participants saw merit in reducing the number of gill net test fisheries in Area 20 from two boats to one based solely on quantitative analysis and associated cost saving. However, given the geographic location of this site with its exposure to the open ocean and proximity to vessel traffic lanes, safety remains a concern for a single boat operating in the area.
2. ***Improve data collection from Food, Social, and Ceremonial (FSC) / Ceremonial and Social (C&S), and Individual Transferable Quota (ITQ) fisheries for in-season use.*** Due to the findings summarized in Section 3.2.4 (Activity #6B), participants saw merit in improving the real-time collection and integration of data from other fisheries.
3. ***Explore consolidation of in-river test fisheries.*** Section 3.2.5 (Activity #7) summarizes findings from a qualitative evaluation of the advantages and disadvantages of different configurations of in-river gill net test fisheries. Although the advantages of alternative configurations were not obvious from this research, participants saw merit in further exploring consolidation or a re-configuration of in-river test fisheries.
4. ***Improve sampling design of Area 12/13 site locations and accounting for local environmental variables.*** Based on findings summarized in Section 3.2.4 (Activity #6A), and anecdotal evidence about the value of accounting for local environmental variables, participants saw merit in improving the sampling design and data being considered by in-season assessment models from Area 12/13 purse seine test fisheries.
5. ***Test use of marine sonar to assess late-run holding in the Gulf.*** Participants identified a continued interest in exploring the feasibility of marine sonar in the Strait of Georgia to provide information about holding patterns of late run sockeye and pink (an activity that remained unaddressed after the first workshop, see Section 3.1).
6. *Improve pre-season planning and administration of test fisheries schedule.* Participants generally agreed that planning efficiencies and cost savings could likely be gained through the clear articulation of decision rules used to guide pre-season planning and in-season deployment of test fisheries that better account for conditions that vary from year to year. This activity remained unaddressed after the first workshop, see Section 3.1. However, experience of the Panel and PSC staff, particularly through the 2015, 2016, and 2017 seasons, demonstrate that while there might be benefits to clearly articulated decision rules and be efficiencies to be found in the planning process it is unlikely that further improvements could be realized relative to these seasons.
7. *Remove test fisheries not used in run-size assessment OR require Parties to fund test fisheries that are only used for domestic purposes.* Participants saw the potential to reduce program costs to the PSC by either eliminating test fisheries that are not used in run-size assessment (e.g., Area 12 gill net (Naka Creek), Area 4B/5 gill net, Area 7 reefnet, Qualark gill net) or having the

individual Parties (Canada and the U.S.) provide funding for these test fisheries (note that Qualark goes hand-in-hand with that acoustics site so does need to proceed to provide species ID information when the hydro-acoustics site is operating).

8. *Reduce redundancies overall throughout test fisheries program.* In general, participants noted that there are a variety of opportunities to potentially eliminate redundancies in the test fisheries / stock assessment programs which should be explored further and implemented where possible to support cost savings (e.g., purse seine test fisheries in Areas 12/13 in years of high abundance, number of gill net test fishery boats in Area 20, in-river test fisheries, Qualark and Mission hydro-acoustics).

9. ***Explore potential for data from other seaward areas / fisheries to provide earlier information (e.g., Gordon Group, West Coast of Vancouver Island, Area 2W).*** Although the key findings in Section 3.2.2 show marginal benefits to in-season estimates and decision making, participants continued to see value in having earlier information from more seaward fisheries, perhaps in locations that might be more reliable than the locations from which data were explored in this study.

10. *Improve marketing and value of pay fish.* An opportunity to increase revenues from pay fish (and reduce financial risks) would be to ensure that these fish garner the maximum price in the market. Some efforts could be taken to improve marketing and the price earned for these fish.

4 Emerging Recommendations

Overall, this series of two workshops to investigate "improvements to Fraser River test fisheries and run size estimates" was considered a success by the advisory committee and among participants since it was able to engage a wide range of perspectives to constructively explore many potential refinements to the existing test fishery program and whether they can still satisfy the needs of decision makers (i.e., maximize the value of information, minimize cost, and minimize fish mortality).

This review involved developing a long list of potential refinements to the test fisheries program and narrowing those refinements to a shorter subset focused on the most critical considerations that required a targeted evaluation (see critical outputs from workshops #1 and #2).[8] It also involved additional research and technical analyses to clarify those refinements around which the evidence suggested there may be benefits of making these adjustments from other refinements around which the evidence suggested there are minimal benefits of making any changes. There are many other refinements that were not explored in detail and around which the advantages and disadvantages remain unclear at this time.

Despite the varied discussions and many considerations brought forward, there are five broad recommendations that emerged from this review. These recommendations are intentionally broad since the specific findings related to individual refinements are described elsewhere in this report. These recommendations include:

(1) Improve pre-season planning and administration of the test fisheries schedule.

There was broad agreement among participants at both workshops that planning efficiencies and cost savings could likely be gained if there was greater transparency, consistency, and clearer rationale around the decision criteria and triggers for deploying different preferred "portfolios" of test fisheries under different conditions. In other words, the Parties should have an agreed suite of test fisheries to deploy in different circumstances. For instance, given the cyclic nature of sockeye salmon returns, the test fisheries that are deployed in years of low abundance with no commercial or International TAC would be different than in years with higher abundance and a commercial or International TAC, and/or the timing of deployment may be different (e.g., delayed starts). If a set of basic test fisheries schedules were available, the Panel could then assume, pre-season, that a particular schedule would be applied unless some emerging conditions dictated otherwise (e.g., actual return is considerably different from pre-season forecast).

Pre-season planning around test fisheries and inter-annual variation in deployment already occurs (see Figure 2 and Figure 3). The process, however, can be better formalized into more explicit decision rules so as to improve the efficiency and effectiveness of proactive planning and in-season response. Factors such as salmon abundance, likelihood of a TAC, timing of test fisheries relative to peak abundance and timing of fisheries, and confidence in abundance estimates would likely be key considerations to best align annual conditions with the preferred test fishery schedule to deploy under a particular set of conditions. To inform the development of these basic schedules it would be helpful to do some analysis of test fisheries deployment in past years. Having consistent yearly data about the performance of the test fisheries program in an easily accessible and consolidated database would facilitate analyses to support such a planning and administrative exercise (e.g., days of operation across different test fisheries, data on cost, fish harvested, revenues from sale fish). Although these data have been consistently gathered for Panel approved test fisheries and are available in various test fishing databases, they could be more routinely summarized and collated.

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[8] Though note that potential refinements to support test fishery assessments for pink salmon were not explored.

(2) Support integration of data from other sources that provide valuable information in a cost effective way for the Fraser River Panel.

There is evidence that catch and effort data from other sources could be beneficial to in-season assessment and decision making (e.g., ITQ/FSC fisheries). The integration of data from other sources is not yet ready to be implemented, but are seen as important to evaluate and explore further as a way of providing critical information in a cost-effective way.[9] As such, further evaluation should be considered a priority as resources and timing allow. It is also important to note, however, that these data need to be provided in a timely manner in order to be usable by the Pacific Salmon Commission if the objective is to contribute to run size estimates. The specific process for gathering, evaluating, and integrating these data in a timely way is not prescribed here. One additional significant concern raised with data from other sources, is that the frequency of their availability would vary with abundance. For example, data from commercial ITQ fisheries directed at Fraser sockeye may only be available once every four years. Opportunities to establish and develop run size assessments using catch data from the FSC fisheries should be further explored.

(3) Leverage the key findings from this review, technical expertise of PSC staff, and priorities identified by participants to confirm the value and need for additional refinements to the test fisheries program.

It was generally agreed among participants that there are a variety of core components to the test fisheries program which are a necessity for in-season assessment and decision making (e.g., Area 12 purse seine and gill net, Area 20 purse seine and gill net, and in-river test fisheries). There was also some interest among participants in having a clear understanding of the specific priority refinements to the test fisheries program that could be implemented. Sections 3.1 and 3.3 provide a summary of the priority considerations that emerged from this review, while Section 3.2 provides a summary of key findings from analyses of specific refinements. What emerged from this review is that there is no clear single solution that will address the competing interests and needs of the varied perspectives, although insights have been gained into the implications of some specific refinements and other changes that have yet to be explored.

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[9] Activity 3 from workshop 1, "Developing a strategy for systematically managing other sources of information and data relevant to in-season fisheries management" was viewed as a critical next step toward ensuring that such information could be consistently evaluated and incorporated (see Section 3.1 above).

Further discussion and decisions remain about which specific refinements should be implemented given the advantages and disadvantages of different alternatives since the trade-offs among competing factors are not obvious or simply based on technical considerations. Below are some examples of how specific refinements need to be explored further:

- The workshop identified that there is an opportunity to reduce costs of the program by eliminating Naka Creek, Area 4B, 5, 6C, U.S. reef net, Qualark gill net, and the Mission pink gill net test fisheries since they are not integral to run-size assessment. However, these decisions depend on the priorities of the Parties and whether these fisheries are seen as critical for other purposes.
- Analyses explored the opportunity for reducing redundancies in Area 20 gillnet test fisheries by moving from two boats to one, but safety concerns were raised about the potential consequences of doing so, a criterion that was not explicitly factored into this review.
- There was also a strong desire among participants for more seaward information to assist in the timeliness of run size and fishery decision making. While there are limited data available, the analyses completed in this review indicated that there is limited value of more seaward information for in-season run size assessment. Participants maintained a desire to have more seaward information for reasons such as stock composition, general changes in overall abundance or timing and distribution. This is one area where future work could focus if additional funding becomes available.
- Analyses suggested the potential for eliminating non-representative purse seine test fish sites in Areas 12 and 13 to better represent the true migratory pattern in the fishing area. Further discussion , suggested that the seine test fish day be modified to extend past the morning hours into the afternoon and evening to better align with tides when fish are known to be moving.
- Several other priority refinements require more information to assess their merits. This review did not have enough information at this time to make decisions related to these refinements:
    - Although in-river test fisheries were identified as a core component of the program, it was also recognized that there may be opportunities to reduce redundancies or reconfigure them (e.g., re-locate Cottonwood).
    - Participants maintained an interest in exploring the feasibility of marine sonar in the Strait of Georgia to provide information about holding patterns of late run sockeye and pink salmon.
    - There was a desire and value in developing more consistent test fisheries schedules to improve the deployment of existing test fisheries to better align with environmental conditions and decision making needs in different years (see recommendation #1).
    - There was strong interest in using data from other fisheries (FSC, commercial ITQ, etc.) for in-season use. This would require an effective and efficient process to be developed for gathering these real-time data and evaluating the value of this information for in-season assessment (see recommendation #2).

Staff with the Pacific Salmon Commission have the best technical expertise and historical perspective to understand the implications of changes to the test fisheries. Their insights alongside key findings from this review and the input from knowledgeable stakeholders should be used to assist the Fraser River Panel in its decision making going forward.

(4) Evaluate and implement potential refinements to test fisheries using a phased process.

Many participants acknowledged that the long-time series of data is one of the key strengths of the current test fisheries program. Using these long time series, statistical relationships have been established that are critical for in-season assessment and modelling. Hence, it will be important to recognize that it may not be possible to implement refinements immediately. A transition period may be required to ensure there is sufficient overlap between historic and new sampling methods, data sources, technologies, configuration, etc. Allowing for such an overlap might mean that there are higher costs to the program in the near term if multiple options need to be implemented at the same time so that scientists can understand the bias and precision of using alternative data sources with in-season processes. A phased approach might also mean that it takes several years to gather data in-season and evaluate its effectiveness post season to assess its value for decision making. This would ensure minimal disruption to in-season assessment and decision making during the transition period.

(5) Explore alternative administrative / funding arrangements for test fisheries between the Parties.

Participants were advised that this review would focus on the technical aspect of the test fisheries. As such, discussions about the administrative / funding arrangements for the program were out of scope. Yet under current conditions, it seems that funding for the test fisheries will remain an ongoing challenge which will have implications on the scope of refinements that might need to be implemented.

5 References

Cave, J. 2017. Analysis of Catch-per-Set Information from the Area B Purse Seine Individual-Transferable-Quota Fisheries. Final Report for the Southern Endowment Fund. 39 pp.

Cave, J., and S. Latham. 2007. Gordon Group Purse Seine Test Fishery. Memo to Pacific Salmon Commission. 3 pp.

Forrest, K. 2012. Evaluation of the area 7 reefnet observation program: 1997-2011. PSC presentation, Victoria.

Gazey, W.J. 2001. Evaluation of in-season abundance estimation from expanded test fishing operations. W.J. Gazey Research, Victoria, 31pp.

Pacific Salmon Commission (PSC). 1997. Examination of the utility of area 2W troll catch data for in-season assessment of Fraser sockeye. Prepared by Pacific Salmon Commission staff. 18pp.

Attachment A: Summary of Past and Current Test Fisheries

					Primary purpose															disposition of encounters			Estimated range of annual cost * * annual expenses vary with cyclic run-size forecasts for sockeye and pink salmon and the subsequent number of charter days * annual costs vary with charter days
					primarily used to provide assessment information on which management group(s)	Monitor or assess salmon migration, diversion rate, migration timing and abundance			Collect biological data including scales, DNA, POF length, sex, weight, species	Used to estimate abundances in													
Test fishery name	Test fishery location	years of operation	Start and end date	Gear description		Qualitative	Quantitative	Research		Marine areas	Commercial catches	US waters	Strait of Georgia	Fraser River at Mission	Features	Non-target species	Rationale for location/procedure	Constraints	Comment	sample fish	payment fish	bycatch	
CURRENTLY OPERATED IN-SEASON FRASER RIVER PANEL APPROVED CORE FRASER SOCKEYE & PINK SALMON ASSESSMENT TEST FISHERIES **(used by PSC Staff in-season for bilateral assessment of Fraser sockeye and pink salmon)**																							
Area 20 gillnet	north of the international boundary in Juan de Fuca Strait, southeast of Vancouver Island. East of Owen Point	Began 1962 and by 1967 was operating continuously except during commercial fisheries. No Commercial gillnet openings in Area 20 since 1990's?? Test Fishery is ongoing	Late June - early July dependant on Early Stuart management needs. Typically ends mid-August dependant on sockeye timing and abundance and management needs	1. 90 mesh, 300 fm 5.125" multi strand gillnet. 2. 120 mesh, 350 fm, 4-panel variable mesh net (4.375" to 5.50")	Assess Early Stuart, Early Summer-run and Summer-run	✓	✓		✓	✓	✓	✓		✓	• Low variability in catch between sets within a day • Allows to assess abundance 6 days prior to migration past Mission • Catch saturation at high abundances • Only inseason assessment tools used to asses Harrison	Most fish are landed including non-target species, which includes Lake Washington sockeye, Puget Sound Pink, Fraser River Coho (some Coho are released alive) and Chinook as well as other Canadian and U.S. stocks. By-catch varies with abundance and catchability	Three vessel rotation with two vessels fishing per night. They fish two sets (dark set and morning set) per night. Effective when sockeye are migratign higher in the water column and are available to gillnet gear • Not used to assess late-run sockeye and pink salmon migration due to fish migration depth and saturation??	Gillnet test fishing data are believed to have greater interannual variability in catchability than purse seine data, particularly for Late-run sockeye and pink salmon. Injury and mortality of non-target species are unavoidable	Beginning in 1996, two vessels test fish per night to ensure that the entire Fraser sockeye migration is monitored to stabilize catch-per-unit-effort. Since 1996 the number of charter days / 3 vessels (3 vessels rotate 2 vessels fishing / night) has been adequate to satisfy the minimum income required from test fishing. Reducing the total number of charter days will likely reduce the number of test fishermen retained	all fish are retained with a maximum of 115 sockeye samples / day	some coho may be released alive otherwise all fish are unavoidably retained	some coho may be released alive otherwise all fish are unavoidably retained. Coho may be sampled	$75000 - $250000
Area 20 purse seine	North of the International boundary in Juan de Fuca Strait, south and west of Vancouver Island between Owen Point and Carmanah Point.	Began 1962 targeting Summer-run and Late-run sockeye and pink salmon. Initially operated during the latter 10 days in August. The test fishery is ongoing	Typically starts at the beginning of the summer run migration around the third week in July and continues through the late run migration and pink salmon migration ending sometime near the end of August - beginning of September depending on Fraser sockeye and pink salmon migration timing, diversion, abundance and management requirements	net depth 875 meshes. westcoast bunt, requires a power skiff	Assess Summer-run, Late run and pink salmon	✓	✓		✓	✓	✓	✓	✓	✓	• Likelihood that the interannual variability in catchability is lower than gillnet data • Provides data on late-timed stock run sizes when the fishery is closed • Allows to assess abundance 6 days prior to migration past Mission • Used to assess stocks at higher abundances • Only inseason assessment tools used to asses Harrison and delaying late run stocks	Injury to non-target species can be negligible if the entire catch is released. When the entire set is retained non-target species may include Lake Washington sockeye, Puget Sound Pink, Fraser River Coho and Chinook as well as other Canadian and U.S stocks	test fish open water sets between ~40 fm and ~180 fm, where sockeye are known to migrate. Sets are attempted to be made perpendicular to shore; however weather and tides may influence set locations. Weather permitting the prefered set location is near the 'blue line'. Six sets are required per day.	High variability in catch between sets within a day. Injury and mortality of non-target species is likely when taking payment fish	The same test fishing vessel and primary crew has been test fishing in Area 20 for more than 35 years providing consistant information	a maximum of 115 sockeye and 100 pink retained for samples / day	as required	released	$129000 - $325000
Area 12 Gillnet Round Island	1 - 1.5 N miles east of Round Island in Queen Charlotte Strait (upper Johnstone Strait)	began 1986. The test fishery is ongoing	Late June - early July dependant on Early Stuart management needs. Typically ends mid August dependant on sockeye timing and abundance and management needs	60 mesh, 200 fm, 5.125" mesh-size multi-strand gillnet	Assess Early Stuart, Early Summer-run and Summer-run	✓	✓		✓	✓	✓	✓		✓	• Low variability in catch between sets within a day • Allows to assess abundance 8 days prior to migration past Mission • Catch saturation at high abundances	Most catch is landed including non target species, including Lake Sakinaw and Nimpkish sockeye, Fraser River Coho (some Coho may be released alive) and Chinook as well as other Canadian and U.S. stocks	Two vessels in rotation with one vessel fishing each night. Overnight fishing; 3-4 sets per night • Not used to assess late-run sockeye and pink salmon migration due to fish migration depth and saturation??	Gillnet test fishing data is believed to have greater interannual variability in catchability than purse seine data, particularly for Late-run sockeye and pink salmon. Injury and mortality of non-target species are unavoidable	Gillnet test fishing in Area 12 started in 1986, operating approximately six days/wk except during commercial fisheries. For the most part, the design of the test fishery is unchanged since 1986 with operation from dusk until dawn	all fish are retained with a maximum of 115 sockeye samples / day	some coho may be released alive otherwise all fish are unavoidably retained	some coho may be released alive otherwise all fish are unavoidably retained	$55000 - $83000
Area 12 purse seine Blinkhorn	a combination of Vancouver Island and west Cracroft Island shore tie off locations between Blinkhorn Peninsula and Fine Beach below Robson Bight in upper Johnstone Strait	began 1986. The test fishery is ongoing	typically starts at the beginning of the summer run migration around the third week in July and continues through the late run migration and pink salmon migration sometime near the end of August - beginning of September depending on Fraser sockeye and pink salmon migration timing, diversion, abundance and management requirements	Net depth is 575 meshes. No power skiff	Assess Summer-run, Late run and pink salmon	✓	✓		✓	✓	✓	✓	✓	✓	• Likelihood that the interannual variability in catchability is lower than gillnet data • Provides data on late-timed stock run sizes when the fishery is closed • Allows to assess abundance 7 days prior to migration past Mission • Used to assess stocks at higher abundances	• Injury to non-target species can be negligible if entire catch is released • Overall mortality of non-target species is less than Area 20 seine • Non Target species may inlcude Sakinaw and Nimpkish sockeye, Canadian and U.S. non Fraser pink, Fraser Coho and Chinook and other Canadian and U.S. stocks	test fish locations vary daily depending on tide, weather, salmon abundance and vessel. Requires 6 sets per day including 1 open water set	High variability in catch between sets within a day. Injury and mortality of non-target species during take of fish for samples or charter payment	prior to 1986 commercial purse seine catch data was used for stock assessment	a maximum of 115 sockeye and 100 pink retained for samples / day	as required	released	$115000 - $277000
Area 13 purse seine	A combination of Vancouver Island and Sonora and Quadra Island shore tie off locations between Ripple Point and Deepwater Bay in lower Johnstone Strait	began in 1995 and continues annually with the exception of 2016	typically starts at the beginning of the summer run migration around the third week in July and continues through the late run migration and pink salmon migration sometime near the end of August - beginning of September depending on Fraser sockeye and pink salmon migration timing, diversion and abundanceand management requirements	Net depth is 575 meshes. Does not require a power skiff	Assess Summer-run, Late run and pink salmon	✓	✓		✓	✓	✓	✓	✓	✓	• Likelihood that the interannual variability in catchability is lower than gillnet data • Provides data on late-timed stock run sizes when the fishery is closed • Allows to assess abundance 6 days prior to migration past Mission • Used to assess stocks at higher abundances	• Injury to non-target species can be negligible if entire catch is released • Overall mortality of non-target species is less than Area 20 seine • Non-Target species may include Canadian and U.S. non-Fraser pink, Fraser Coho and Chinook and other Canadian and U.S. stocks	test fish locations vary daily depending on tide, weather and salmon abundance. Requires 6 sets per day including 1 open water set	High variability in catch between sets within a day. Injury and mortality of non-target species during take of fish for samples or charter payment	Area 13 purse seine test fishing started in 1995, fulfilling a recommendation to the Fraser River Panel (PSC Tech Rep. 6) to monitor the escapement of sockeye and pink salmon following commercial fisheries in Johnstone Strait. The general quality and usefulness of the information has been adequate, however, the priority for test fishing in Area 13 is lower now with the much reduced frequency of commercial fisheries in Areas 12 and 13	a maximum of 115 sockeye and 100 pink retained for samples / day	as required	released	$0 - $231000
Area 29 Cottonwood Gillnet	lower Fraser River, northwest of Tilbury Island between ship navigational markers S28 and S30	began in 1962. The test fishery is ongoing	typically from early July to early-mid September, depending on cycle year requirements.	In 1992 for the first time, a variable mesh gillnet was used at Cottonwood. The net has four panels with mesh sizes of 4.25, 4.75, 5.25, and 5.75 inches, each at 40 fathoms long (160 fathoms total length) and equivalent to a depth of 75 meshes of depth at 5.25 inches. This net was designed to obtain a more representative sample across all sockeye sizes. Begining in 2009 Multi-strand, 4-panel variable-mesh net, 4.25" to 5.75" mesh x 100 fm intergrated with a pulsed low voltage DC electric gradient	• Collect biological information • Assess in river sockeye abundance on years with large in-river pink salmon abundance	✓	✓		✓				✓	✓	• Provides abundance information with a one- to two-day lead time on Mission • Provides scale samples which include Upper Pitt River sockeye • Electric net reduces seal predation increasing the number of fish retained for samples, particularly useful during low migration abundances	• All catch are landed including non-target species, non-target species may include Fraser Coho and Chinook, all sturgeon are released alive • Beginning in 1998, coho and chinook catches have been sampled for DNA stock composition analysis	One 30 minute set per day on the flood tide (when the river current slows, or stops running). When migration abundance and test catches are low we sometimes make additional sets to increase sockeye sample size	Some concern about bias in stock composition estimates using Cottonwood test fishing data. Difficulty achieving sample sizes required for stock ID, at times. Susceptible to variability in water level. Susceptible to seal predation, particularly during low sockeye abundance. Injury and mortality of non-target species are unavoidable. does not sample the North Arm of the Fraser River migration route	Test Fishing started at Cottonwood in 1962, but test fishing occured in 1958 and possibly as early as 1957 in the vicinity of the present day Cottonwood drift. The test fishery is used to monitor the daily upstream abundance of sockeye by stock and pink salmon. Cottonwood is no longer used for estimates of abundance (Mission hydroacoustic estimates are used) although there are some exceptions for Late-run sockeye during the pink salmon migration and for the Pitt River sockeye population. The program is required for biological samples	all fish are retained with a maximum of 50-100 sockeye sampled / day	some coho may be released alive otherwise all fish are unavoidably retained	some coho may be released alive otherwise all fish are unavoidably retained. Coho and Chinook are sampled	$56000 - $72000
Area 29 Whonnock Gillnet	lower Fraser River, begins at the bottom end of or downstream of Cresent Island	began 1958. The test fishery is ongoing	typically begins late June and operates daily through late September or early late October depending on cycle year and daily migration abundance	Variable mesh gillnets have been used at Whonnock since 1977 with panels of mesh sizes of 4.00, 4.625, 5.25, 6.00, 6. 7.5, 7. 75 and 8. 75 inches (at 25 fathoms per panel and 175 fathoms total length). Since 1986, the 8.75 inch mesh has not been included in the net. Multi-strand, 7 panel variable-mesh net, 4" to 8.5" mesh x 175 fm	• Collect species composition information • Assess in-river sockeye abundance	✓	✓		✓				✓	✓		• All catch are landed including non-target species, non-target species may include Fraser Coho and Chinook, all sturgeon are released alive • Beginning in 1998, coho and chinook catches have been sampled for DNA stock composition analysis	Two 20 minute sets per day on the flood tide (when the river current slows, or stops running)	Some concern about bias in stock composition estimates using Whonnock test fishing data. Injury and mortality of non-target species are unavoidable	Test Fishing at Whonnock started in 1958 to monitor the daily upstream abundance of sockeye by stock and pink salmon. Upper Fraser River gillnet test fisheries did occur as early as 1954 at the Dravey ard Drift near the Whonnock channel drift. During high discharge periods, the test fishing is conducted at Glen Valley Bar. At lower water levels, the Whonnock Channel drift is fished. The program is required for biological samples	all fish are retained with a maximum of 50-100 sockeye samples / day and 100 pink sampled / week	some coho may be released alive otherwise all fish are unavoidably retained	some coho may be released alive otherwise all fish are unavoidably retained. Coho and Chinook are sampled	$77000 - $104000
Area 29 Gulf Troll	southern Strait of Georgia between Bowen Island and US and Canada boundary	began 1987, depending on cycle year requirements. The test fishery is ongoing	typically between August 10-September 30, depending on late-run abundance and migration timing	6 gurdies, 12-14 hooks / gurdy	Assess Late-run sockeye delay	✓	✓		✓				✓		• Provides for several sequential estimates of abundance over the season • Provides a perspective of the timing of the upstream migration	• Encounter rates of non-target species are low • Mortality of these species can be negligible with careful handling of gear	Test fishing in Area 29-3 to 6 with trollers commenced in 1987. In 1989, the test fishery was redesigned with two vessels systematically fishing six defined sections of the area (quadrants)	Susceptible to changes in the availability of fish to the troll gear. Catch rates drop when sockeye move onto the "flats" of the Fraser River delta and/or migrate upstream prematurely		a maximum of 115 sockeye samples / day	as required	released	$0 - $70000

					Primary purpose															disposition of encounters			Estimated range of annual cost * * annual expenses vary with cyclic run-size forecasts for sockeye and pink salmon and the subsequent number of charter days * annual costs vary with charter days
					primarily used to provide assessment information on which management group(s)	Monitor or assess salmon migration, diversion rate, migration timing and abundance			Collect biological data including scales, DNA, POF length, sex, weight, species	Used to estimate abundances in													
Test fishery name	Test fishery location	years of operation	Start and end date	Gear description		Qualitative	Quantitative	Research		Marine areas	Commercial catches	US waters	Strait of Georgia	Fraser River at Mission	Features	Non-target species	Rationale for location/procedure	Constraints	Comment	sample fish	payment fish	bycatch	
CURRENTLY OPERATED IN-SEASON FRASER RIVER PANEL APPROVED SOCKEYE & PINK SALMON TEST FISHERIES **(provide supplemental information on Fraser sockeye and pink salmon and other species, but not used by PSC Staff for run-size assessment models)**																							
Area 12 Gillnet Naka Creek	In the vicinity of Naka Creek below Robson Bight in upper Johnstone Strait	began 2009 until present with the exception of [illegible]	Overlaps 10 nights in late July with the Area 12 Gillnet Test Fishery	80 mesh, 200 fm 5 1/8" twisted nylon filament ([illegible])	• Assess Early Stuart, Early Summer run and Summer run • Provide another index of abundance comparable to the Round Island gillnet test fishery	✓			✓	✓	✓				refer to the Naka Creek review presentation I did a few years ago	All catches are landed including non target species				all fish are retained with a maximum of 115 sockeye sampled / day	some coho may be released alive otherwise all fish are unavoidably retained	some coho may be released alive otherwise all fish are unavoidably retained	$[illegible]000 - $[illegible]000
Area 4B, 5 Gillnet	US side of Juan de Fuca Strait between Kydaka Point and Pillar Point	Began in 2006 to monitor sockeye migration on the US side of Juan de Fuca Strait. Operated every year since 2006 with the exception of [illegible]	Typically starts 7 - 10 days prior to the planned start date for the Areas 4B, 5 and 6C Treaty commercial gillnet fisheries	300 mesh, 440 fm 5 1/8" twisted nylon filament gillnet	Assess Early Stuart, Early Summer run and Summer run	✓			✓		✓	✓				All catches are landed including non target species			[illegible] 10 days prior to opening	all fish are retained with a maximum of 115 sockeye sampled / day	all fish are unavoidably retained	all fish are unavoidably retained	$0 - $[illegible]000
Area 7 Reefnet Observation	US San Juan Islands	began 1997. Ongoing Reefnet observations did also occur in [illegible] and early 1970's	Typically starts mid-July and continues through the late run migration and pink salmon migration. Dependant on Fraser sockeye and pink salmon migration timing, diversion, abundance and management requirements. Does not operate during US Area 7 / 7A reefnet commercial openings	reefnet platform	Confirm abundance of Fraser River sockeye (excluding Early Stuart) and pink salmon	✓			✓		✓	✓			Covers all major migration routes through United States Panel Area waters	• Provides observations with zero mortality of all species • Encounter rates of non target species are low • Mortality of these species can be negligible with careful handling of gear	Observations for approximately 8 hours per day, depending on tides. Three reefnet gear are used for observations at Henry Island, San Juan Channel and Lummi Island	Highly susceptible to environmental conditions. Overcast skies, rain, winds, tides and water clarity affects the consistency of observations. The fixed gear positions do not allow movement to better sites as fish distribution changes. Payment fish must be taken by additional reefnet gear and/or by other test fishing programs	Payment fish are taken by additional reefnet gear with a reduced net price per pound received for payment fish	as requested	as required	released	$[illegible]000 - $[illegible]000
Qualark Gillnet	west bank of the Fraser River at the Qualark hydroacoustic site, [illegible] of Yale in the vicinity of Emory Creek	2000 [illegible] - ongoing	late June - September depending on salmon abundance and cycle year	six mesh sizes ranging from 4", 4.75", 5.25", 5.75", 6.75", and 8" x 60'	Provide stock and species composition information for the hydroacoustic program at Qualark			✓	✓							All catches are landed including non target species	Six to seven, five to seven minute sets per day with three in the morning and three in the afternoon using 6 different mesh sizes. Typically one set per day is done offshore otherwise all sets are nearshore	Injury and mortality of non target species unavoidable. Concerns about bias species composition. Different catchabilities by species. Concerns about pink saturation with pink migration abundance. Concerns about number of samples taken and mesh size selectivity		all fish are retained with a maximum of 115 sockeye sampled / day and 50 pink / week	some coho and chinook may be released alive otherwise all fish are unavoidably retained	some coho and chinook may be released alive otherwise all fish are unavoidably retained	$[illegible]000 - $[illegible]000

Attachment B: Proceedings from Workshop #1

Improving Fraser River Test Fisheries and Run Size Estimates: Workshop #1 Summary

Prepared for: PSC Fraser River Panel
Prepared by: Marc Nelitz and Alex Hall, ESSA, Vancouver, BC

Introduction

This report provides a brief summary of the first of two workshops on reviewing the Fraser River Test Fisheries program.

Background

The Pacific Salmon Commission, or its predecessor the International Pacific Salmon Fisheries Commission, has operated test fisheries to obtain data required to inform bilateral decisions of the Fraser River Panel since the 1960s. The information gathered from these test fisheries is regularly used in conjunction with information from the in-river hydro-acoustics programs to provide estimates of timing and in-season run size of Fraser River sockeye salmon management units.

The Fraser River Panel and Pacific Salmon Commission are undertaking a review of test fisheries to identify opportunities for refining the test fishing program in a way that ensures it can provide high quality information, minimize costs, and minimize fish mortality. As part of this study, two workshops are being held to gather technical input from scientists, decision makers, First Nations/Tribes, and stakeholders from both Canada and the United States.

The primary drivers for the overall review are a need to ensure:

- Best possible assessment programs that can be supported with available budgets;
- Adequate discussion of program elements because the program is extremely costly and there is currently no secure source of funds to pay for them;
- High-level suggestions that have come forward about alternate opportunities for collecting data (e.g. other fisheries, alternate technologies) are identified and discussed; and
- Overall assessment program is reviewed given that a review of the hydro-acoustics program currently underway.

Purpose and Scope of the Review

The purpose of this review is to identify opportunities for refining/improving the test fishery program to ensure it provides high quality information to inform the Fraser River Panel in making decisions regarding management of Fraser River sockeye and pink salmon, while minimizing costs.

The scope of this review includes:

- A technical evaluation;
- All Fraser Panel-related test fisheries in freshwater and marine environments and within Canadian and US waters;
- Criteria for comparing strengths/limitations; and
- A consideration of new alternatives for collecting key information, including alternate technologies

The scope of this review does not include:

- A review of administrative arrangements for test fisheries
- A review of cost structure/arrangements between the two countries

Workshop Objectives and Process

A 2-day workshop was held in Vancouver, British Columbia on November 2, and 3, 2016. The workshop agenda is provided in Appendix A. It was attended by 31 participants (see Appendix B) representing a broad cross-section of interests (e.g., Canada and US, technical and policy, fishery sector and regulators, First Nations/Tribal and non-aboriginal). The objectives of the first workshop were to:

1. Develop a common understanding of existing test fisheries (TFs) in a way that helps identify strengths / limitations with the current program;
2. Review performance criteria for comparing strengths and limitations of test fishery options;
3. Identify options for test fisheries / data that could augment the information currently being collected; and
4. Gather input on next steps to further evaluate these options after the workshop.

Day 1 of the workshop focused on developing a common understanding about the current test fishery program and its strengths/limitations (see Sections 2, 3, and 4 below). Participants were split into sub-groups on Day 2 and tasked with generating test fishery alternatives under different salmon abundance scenarios that were seen as addressing the strengths/limitations identified on Day 1. Discussions from Day 1 and 2 were then used as the basis for identifying priority activities to undertake in the next steps of the review and technical evaluation of the current test fishery program (see Sections 5 and 6 below).

The workshop agenda and task process were developed during the late summer and early fall in consultation with a planning team representing a subset of the Fraser River Panel. We developed several additional components to support the workshop. These components included an evaluation framework, which included a draft set of considerations for comparing the strengths and limitations of different test fishery options. We also compiled background information from the PSC on existing and historic test fisheries (including a high-level snapshot, detailed summaries, and maps of test fishing locations). Lastly, we created a template for describing alternative test fishery options that participants could use to consistently provide their input prior to the workshop.

Several weeks in advance of the workshop participants were given the opportunity to use this template to submit potential alternative test fisheries that they wanted to be considered as part of the workshop deliberations. In support of this exercise, an additional conference call was held to answer questions about the template. Within this template, participants were also asked to answer three questions regarding the major strengths and weaknesses of the existing program and share their concerns about potential modifications.

Background on Test Fisheries

To ensure all participants had a common understanding of the structure and function of the existing test fishery program (i.e., workshop objective #1), Mike Lapointe (PSC) delivered a background presentation to address the following questions:

- How are current test fisheries operating? Key changes from past operations? Why?
- What are the key decisions and critical information needs?
- What are the past/future scenarios under which test fisheries need to operate? What are the key factors that discriminate these scenarios?
- What test fishery strategies are used to address these scenarios?
- What does a strong / ideal test fishery look like?
- What are the strengths / limitations in the current program? Why?

Addition background information on existing and historic test fisheries was also distributed to workshop participants prior to the workshop.

Perspectives of Participants

Two strategies were used to understand the breadth of concerns of participants at early stages of the engagement process. As noted above, participants were provided an opportunity to respond to three question about their perception of the strengths and weaknesses of the existing program and concerns about potential modifications prior to the workshop. In addition, the workshop began with a round-table discussion where each participant was asked to share their major hopes and/or concerns about the possibility of modifying the current test fishery program. Based on input provided through these different approaches, a summary of the perspectives of participants on the review and the test fishery program is provided below.

What are your hopes for or concerns with the possibility of modifying the current test fishery program?

Need to change...

- Respond to changing objectives for the management system
- Modify timing/location of test fishing to reflect environmental conditions and local observations

- Compile the results of harvests from all sources into the analyses to provide more timely results from the marine run size model
- Explore increased opportunities for FSC involvement (existing capacity, timely data)

No concerns as long as…

- Changes and data are accepted in a timely manner
- Info would not preclude U.S. from harvesting Sockeye and Pink TAC in Area 7/7a
- There is no significant reduction in the ability to assess the components of Fraser sockeye and pink returns

Need for rigorous evaluation and scrutiny of any new alternative

- Existing data and methods have undergone significant R&D - any alternatives would need to undergo similar scrutiny
- Could be long transition period (operating old and new) to evaluate new TFs
- Ensure valid evaluation of the strengths and the weaknesses of existing test fisheries before modifying

Elements that should be maintained

- Everyday presence of the test fisheries; do not sacrifice current programs
- Mission hydro-acoustic estimates extremely important in understanding catchability
- Maintain capacity for test fishing

Concerns about the process of making decisions about potential modifications to program

- Transparency and consultations outside this process
- Basing decisions on fiscal constraints rather than scientific evaluations of impacts
- Considering wholesale changes prior to renegotiating Chapter 4
- Making changes that suit harvester groups rather than Treaty objectives
- Don't want process to drag on for years

Decrease in quality of information

- Increase in variability of the information relevant to informing marine fisheries
- Impacting information needed to manage domestic fisheries in Canada
- Need to have good data – do not compromise on this

Financial concerns

- Promoted changes will increase cost
- Test fishers need to make enough money to make participation worthwhile
- Focus on cost may preclude consideration of progressive, beneficial ideas

Erosion of test fishery program

- Need to define "current". If 2016 program is new baseline, further reductions could jeopardize entire program.
- Cannot go backward from where it is now – lowest possible point and can't be made worse

Previous efforts started well but test fishing aspect lost focus (e.g., focus on Food Fish / commercial harvest)

Scale of TF needs to align with scale of management

- Current program generally meets current management needs; but management changing, with potential divergence of scales

- Solution needs to be manageable to apply in-season

Strengths and Limitations of Current Test Fisheries

To provide a structures and systematic way of evaluating any test fishery alternatives that were brought forward at the workshop, the facilitators worked with the planning group in advance of the workshop to develop an evaluation framework and set of performance criteria against which any new test fishery alternatives could be compared. These performance criteria included the following considerations:

1. **Value of the information**
    a. Type of information
    b. Timing of information
    c. Quality of information
    d. Relevance of information to Fraser River Panel management decisions
2. **Financial**
    a. Cost to implement
    b. Revenue from sample fish
3. **Fish mortality**
    a. Target species
    b. Non-target species

These criteria were reviewed and discussed with the workshop participants. In addition, participants were asked to provide their open-ended views on the strengths and/or limitations of the current test fishery program.

The following two sections provide a summary of the main strengths and weaknesses of the existing TF program, as identified by workshop participants through both the pre-workshop survey and discussions at the workshop. It was important to understand the strengths of the current program to identify what is important to keep, as well as understand the limitations in the current program to identify what might need to be adjusted.

Strengths

- Critical information for decision making
- Long time series over which some extremes have been observed
- Multiple years of data from different areas
- Consistency in program (in skippers, boats, gear, etc)
- Provides opportunity to experiment with alternative technologies
- Good coverage of migration pattern (in general)
- Areas 12 and 13 as independent estimators
- Round Island and San Juan test fisheries
- Good communication of in-season information
- Recent improvements in estimates at Mission
- Panel able to identify weak runs in a timely way
- Provides timely information

Limitations or Gaps

- Lacking an evaluation of the value of information
- Implementation costs
- Spatial coverage
- Need for geographic expansion north of Port Hardy
- Consideration of tides and weather
- Timeliness/better early warning (mismatch in timing and precision between data obtained from marine TF and information obtained from Mission)
- Minimal use of FSC
- Additional TF sites upriver
- High variation in catchability (within year and across years)
- Challenges dealing with in-season uncertainty around data and management systems
- Dealing with late run holding
- Mismatch between in-season and post season estimates
- Gillnet 4B, more offshore

Test-Fishery Portfolios

For Day 2, participants were divided into five subgroups to work on developing a "portfolio"[10] of test fisheries under three different scenarios of salmon abundance:

1. High abundance sockeye, non-pink year (e.g., 2014 cycle)
2. Moderate abundance sockeye, pink year (e.g., 2013 and 2015 cycles)
3. Low abundance sockeye, non-pink year (e.g., 2016 cycle)

Participants were asked to consider different salmon abundance scenarios, because it was recognized that test fishery needs are likely to vary significantly across these scenarios. All five groups were asked to develop a test fishery portfolio for Scenario 2. Afterwards each sub-group was then asked to develop a portfolio for one of the other scenarios. For each scenario, the groups were asked firstly to consider how they would modify the existing TF program (without adding new TFs) and secondly to identify potential substitutions and/or new TFs to add to the existing program. To assist with deliberations, each of the sub-groups was provided with graphs of daily abundance by management group and the corresponding test fishing schedule across the season for each scenario, maps of TF locations, a summary of the various options raised during the workshop (see Appendix C), and a summary of the perceived strengths and weaknesses of the existing program identified by participants.

A summary of the key discussion points from the sub-groups as related to the different abundance scenarios is provided in Sections 5.1, 5.2, and 5.3. After sub-groups had reported out on their individual discussions, participants were asked to reflect on the emerging and common themes that were raised across sub-groups and scenarios. Section 5.4 summarizes some of the themes that emerged from this discussion.

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[10] A test fishery "portfolio" was defined as the full combination of individual test fisheries that would need to be operated in a given year to meet assessment and decision making needs.

Each of the groups developed their potential portfolios independently. These were reported back to the group but there was no exercise of reconciling differences and developing a commonly supported hybrid of the ideas put forward. The sections below represent the input from all the groups. Where groups had similar ideas, those have been consolidated but there are also conflicting ideas. To aid the reader, ideas that are mutually incompatible are identified in *purple italics*.

Scenario #1: High Abundance Sockeye (no pink salmon)

Overall

- Keep TFs going
- Delay start of TFs to protect Early Stuart
- Need to trust/accept the data that is received

Marine TFs

- Area 12 Round Island – leave alone
- Area 12 Naka Cr – 3 days prior to commercial opening
- Area 12 PS – leave alone
    - Flexibility to Area 12 Seine location in addition to standard set especially if lack consistency between area 12 + 13 data
- Area 13 PS – leave alone
- Gulf Troll – possible removal (with substitution)

- Area 20 PS & GN – leave alone
    - Add 2nd purse seine boat closer to Area 19 line to validate Area 20
- Area 4B/5 – 3days prior to commercial opening
- Area 7 RN – 3days prior to commercial opening

In-river

- Cottonwood – leave alone
- Whonnock – leave alone (for species ID)
- Qualark – leave alone (if Qualark hydro-acoustics is continued)

Suggestions for potential substitutions and/or additions

- Initiate Gordon Group TF
- Utilize CPUE in seine ITQ
- US CPUE info could be helpful
- Utilize FSC data PS & GN
- Flexibility to add test fisheries in 4B/5/6C/6
- Move Area 12 GN (Round Island) to Naka Creek
- Replace Area 12 GN with Roller Bay GN
- Replace Naka Creek with TF seaward of Area 12 (Roller Bay, Cape Caution, Gordon Group)
- New – in-river TF above Hell's Gate
- New – Area 2W troll TF

Scenario #2: Moderate Abundance Sockeye (plus pink salmon)

Overall

- Delay start of TFs to decrease cost and protect Early Stuart and Early Summers
- Need to trust/accept the data
- Shift to intensify TF effort to whenever it's most appropriate for Sockeye and pink runs to maximize precision as run builds, then reduce TF effort once peak is confirmed

Marine TFs

- A12 & A20 – same as Scenario 3
- Naka Creek – expand dates IF we think we want this to replace A12, otherwise drop TF
- A13 – evaluate potential for stock ID for Pinks (not needed for Sockeye estimates)
- *A12 & A13 - increase effort in order to reduce estimate variability in Sockeye and Pink (A13)*
- *Alternatively – alternate 2 boats in Area 12 PS; just 1 boat in Area 13 PS*
- A29 Gulf Troll – drop TF (see substitute)

- Area 20 – 1 GN boat
- Area 4B/5 & Reef Net – 3-5 days in advance of scheduled openings

In-river

- *Cottonwood*
    - *Drop TF (see Scenario 3) - expect higher sample size at Whonnock with greater abundance therefore there is less need for Cottonwood*
    - *Alternatively - if sample size can be maintained then continue Cottonwood*
- Whonnock – longer duration to cover Pink migration (may be relatively minor extension in some years)
- Qualark – defer to hyrdroacoustic review

Suggestions for potential substitutions and/or additions

- Consider "full fleet TF" to assess pinks – would need sockeye TAC.
- Small Area B fishery for Pink assessment with Sockeye TAC
- Deploy vessel for systematic observation when in doubt
- Consider deploying something like Area E TFs (assessment fishery) to increase sample sizes used for stock identification.
- Early Seaward assessment – Gordon Group starting with ESum timing.
    - Gordon Group (seine) instead of Cottonwood
- Add – Cape Mudge sonar
- A29 Gulf Troll - mobile sonar surveys, on both marine approaches
- Small intense fishery opening to assess "standing stock" in gulf
- US CPUE and/or Cdn ITQ CPUE -- look at data & usefulness in assessing Pink and Sockeye abundance

Scenario #3: Low Abundance Sockeye (no pink salmon)

Overall

- Later start and earlier finish to save money and fish

  - Based on pre-season forecasts, adjusted to anticipate return.
- Consider extending GN in low abundance years and delaying start of seines

Marine TFs

- Could probably drop A20, A12 & A13 PS TF in years when we are really certain that we're not expecting any Chilko SK (i.e., not expecting any international TAC)
- Adjust A12/A20 TFs based on diversion rate (except for Chilko scenario)
  - If Northern Diversion is high, maintain A12 and end A20 early (and vice versa) at the end of the run or few days after peak (only for SK years)
- Use full suite of fisheries
- 3rd wk July to 3rd week Aug (Marine TF) - with reduced timeframe, with ability to shut down fisheries early.

Northern approach

- *A12 GN – no change and/or potentially flexible end dates*
  - *Alternatively – drop Naka Creek GN (not used for run size estimate)*
- Area 12/13 PS – leave start date alone, flexible ending data if passed peak in abundances
  - *Need A13 PS even in reduced program years, to corroborate A12*
  - *Alternatively – don't need A13 PS in low abundance years (e.g., not run in 2016)*
- A29 Gulf Troll – remove –not needed/ can't use data in low abundance years

Southern Approach

- A20 GN
  - start late in low Early Stuart years
  - start date moved 10 days later to July 10
  - reduce to 1 boat
- Area 20 PS
  - same as Area 12 justification (start date as scheduled, flexible and date)
- US southern approach TFs
  - 4B/5/6C – don't need in low abundance years
  - Run only one of A4B, A5 or Reef Net
  - take 4B/5 off the water – C&S gives est. prior to commercial opening
  - A7 RN – open a few days prior to potential US fishery – if no US TAC, no TF (not used for abundance)
- *Alternatively – no refinement to Southern approach recommended*

In-river

- Look at potential redundancy among in-river TFs (Cottonwood/Whonnock/Albion)
  - Look for opportunities to amalgamate
- Whonnock
  - Leave alone for Mission species ID
  - Is there any way to increase sample size?
- Drop Cottonwood – explore extra sets at Whonnock & explore use of data & fish from Albion.
- Qualark
  - Leave alone if Qualark hydro-acoustics operating
  - Dependent on hydro-acoustics review – probably drop in low abundance years

- *Alternatively – no refinement to in-river test fisheries recommended*

Suggestions for potential substitutions and/or additions

- Move Area 12 GN to Naka Creek
- Naka Creek GN modification – Initial FSC opening in A12, then Naka Creek TF, then A13 GN FSC

- Sonar – Area 13 (e.g., Cape Mudge)
- Add – Roller Bay GN
- Add – Gordon Group – GN? PS?
- Add – C&S

- When conflicting information from FSC fisheries & Area 12 test fishing, either:
    - Flexibility to move Area 12 PS boat to Area 13, or
    - Add another Area 13 boat
- Use FSC data
    - Include FSC PS & GN data from Area 13/ Johnstone Strait (whether or not fishing Area 13 TF boat)
    - A13 Seine & Gillnet – use FSC data
    - Cottonwood Gillnet – use FSC fisheries for stock ID

- Whonnock – Hybrid Albion TF in place of Whonnock, depending on Mission status
- New – In-river TF above Hell's Gate

Common Themes Across Scenarios

Commonalities especially relevant to medium/high abundance years

- More seaward indicators
- Exploring use of sonar
- Elimination of Cottonwood
- Naka Creek – current implementation is not helpful – expand or move or eliminate
- Potential move away from Round Island
    - Roller Bay – earlier timing, more seaward
    - Naka Creek – more representative information geographically (narrower geographic constraint)
- Above certain abundance, commercial fleet is in water – do you really need TFs then?

Commonalities especially relevant to low abundance years

- Flexibility in timing of TFs – e.g., delayed start, early termination
- Drop varying non-assessment fisheries
- Use C&S fisheries in US Area 4, 5

There was general acceptance that a less intense program is needed during lower abundance years, but there was a hope that a more intensive (than current) program could be conducted during high abundance years. The varying assessment programs in relation to abundance level was related to two main factors: (1) management need (e.g. fewer fisheries, especially in marine areas, in years of low abundance), (2) availability of data from alternate sources (e.g. more commercial fisheries on high abundance years). The group identified few differences in the test fisheries program to differentiate between years with high abundance sockeye (e.g. 2018) and moderate abundance sockeye plus pink (e.g., 2017 & 2019).

Critical Needs for Further Evaluation

Near the conclusion of the workshop, participants were asked to reflect on the test fishery portfolios and commonalities that emerged from the sub-group portfolio discussions. Based on these commonalities and the emerging themes, participants were asked to provide suggestions on the next steps and critical technical needs that would provide a stronger technical basis for identifying and evaluating adjustments to the current test fishery program. A summary of these critical needs is provided below. Based on these needs, participants were then asked to propose technical activities that could be undertaken by the project team (ESSA, PSC staff, and others) in the next 6 months to address these needs (summarized in Table 1).

Critical Needs

1. Need for more seaward, more timely, information relative to where catch allocations are.
2. Need for better integration of commercial (and other) information, but recognitions that commercial data and data from other sources is not consistently available and is not typically collected in a manner that is consistent with test fishery info. For instance, there may be an opportunity to develop a management system that isn't so dependent on test fishery data (i.e., a system where it's easier to open commercial fisheries and use them as part of your assessment tool box).
3. Desire to minimize apparent discrepancies of test fishery vs. other information.
4. Recognition of need for improvement and concerns about "knee jerk" reaction with overemphasis on costs
5. Recognition of cyclic nature of abundance in returns across years and desire to buffer impacts of low years with greater test fish harvests in abundant years.
6. Concern expressed about how Conservation, Test fishery and FSC needs interact
7. Desire to better integrate environmental data
8. How do we improve the way we both quantify and promote the value of information from the test fisheries? E.g., quantify implications of not having certain elements on potential foregone harvest opportunities.

After the First Workshop

Subsequent to this workshop, a subset of the planning group was convened to further prioritize the activities in Table 1 below based on their feasibility to complete in the next few months and the value of information that would be provided to the Fraser River Panel. Priority activities were then submitted in a year 2 proposal to the Southern Endowment Fund to request resources that would be used to undertake a subset of these activities. If funded, a second workshop would be convened in May 2017 to review the findings from these activities and help inform decisions on next steps by the Fraser River Panel.

Table 1. Priority areas for further review and evaluation that emerged from the workshop (in no order of importance). The four right-hand columns represent a classification of the broad types of activities included within each area

Priority Areas for Further Review and Evaluation	New Analyses of Existing Data	New Data	Documenting Historic Analyses and Data	Data Management Strategy
1. **Developing decision rules and/or heuristics to guide pre-season and in-season deployment of test fisheries under different scenarios and conditions** a. How to better deploy what TF you have (e.g., decision flow for portfolios and scenarios) b. Different scenarios could include: salmon abundance, TAC, species, confidence in abundance estimates, timing relative to peak abundance)			X	
2. **Reviewing existing test fisheries to better understand their relative value and non-Panel uses and benefits** a. Review of existing TFs – relative value; different uses b. What are the other uses and benefits c. Should those be part of Panel TFs or other			X	
3. **Developing a strategy for systematically managing other sources of information and data relevant to in-season fisheries management** a. e.g., ITQ, FSC fisheries, etc.	X		X	X
4. **Improving timeliness of in-season information by the use of data from fisheries more seaward than current configuration** a. Compile and review existing studies/memos b. Compile info/data and analyze it c. Existing seaward CPUE and relationship to Fraser CPUE	X		X	X
5. **Evaluating alternative configurations of test fisheries in Johnstone Strait** a. Explore and analyze potential redundancies among test fisheries b. e.g., replacing Round Island with Naka Creek plus new TF	X		X	
6. **Evaluating representativeness of purse seine test fisheries in Areas 12 and 13** a. Too broad, need to narrow analysis for particular question – what are trying to achieve? b. Resample TF data (internal) OR set-by-set ITQ (external) c. How to supplement existing with others	X		X	
7. **Reviewing and refining the current suite of in-river test fisheries** a. Data mining, explore possibilities to reduce from 3 in-river TFs to 2 b. Cottonwood data – long history, stock ID c. Alternate platforms for stock ID (Albion – mesh size) d. Comparison of samples	X		X	
8. **Evaluating the feasibility of alternative technologies for estimating in-season abundance in the marine environment** a. e.g. side-scanning sonar b. Marine supplement to Mission hydro-acoustics (e.g., SEF proposal)	X	X		
9. **Improving the understanding of holding patterns of late-run sockeye and pink salmon in the Strait of Georgia** a. Radio-tagging in Gulf, working UBC/SFU b. Scott Hinch - ocean telemetry work/acoustic (big cost)	X	X		

Appendix A: Workshop Agenda

PSC Fraser River Panel

Improving Fraser River Test Fisheries and Run Size Estimates: Workshop 1

Workshop Agenda

November 2-3, 2016

Fisheries and Oceans Canada
#200 - 401 Burrard Street, Vancouver BC
https://goo.gl/maps/F9LDG61B1ts

Project Leads:

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Workshop Facilitators:

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Project Background and Goal:

The Pacific Salmon Commission, or its predecessor the International Pacific Salmon Fisheries Commission, has operated test fisheries to obtain data required to inform bilateral decisions of the Fraser River Panel since the 1960s. The information gathered from these test fisheries is regularly used in conjunction with information from the in-river hydro-acoustics programs to provide estimates of timing and in-season run size of Fraser River sockeye salmon management units.

The Fraser River Panel and Pacific Salmon Commission are undertaking a review of test fisheries to identify opportunities for refining the test fishing program in a way that ensures it can provide high quality information, minimize costs, and minimize fish mortality. As part of this study, two workshops are being held to gather technical input from scientists, decision makers, First Nations/Tribes, and stakeholders from both Canada and the United States. This workshop marks the first of these two meetings.

Pre-Workshop Reading and Homework:

- Evaluation framework for comparing strengths and limitations of test fishery options
- Background information on existing and historic test fisheries (overview and detailed summaries, map of test fishing locations)
- Template for describing alternative test fishery option(s) to consider

Workshop Objectives:

(1) To develop a common understanding of existing test fisheries in a way that helps identify strengths / limitations with the current program;

(2) To review performance criteria for comparing strengths and limitations of test fishery options;

(3) To identify options for test fisheries / data that could augment the information currently being collected; and

(4) To gather input on next steps to further evaluate these options after the workshop.

Day 1

Approx time	Topic	Contributors
8:00	Arrival – *Participants will need to allow some time to sign in with commissioners on 2nd floor*	
8:30	**Welcome and introductions**	Panel chairs, participant introductions
8:45	**Overview of agenda**	ESSA
9:00	**Context and scope of this review**	Project leads
9:30	**Perspectives of participants about this review**	ESSA facilitating, participants contributing
10:30	Break	
10:50	**Background on test fisheries**	PSC presenting, questions from participants
12:00	Lunch (provided)	
1:00	**Strengths / limitations of current test fisheries**	ESSA facilitating, participants contributing
2:00	**Evaluation framework**	ESSA facilitation, questions from participants
2:40	Break	
3:00	**Options under consideration**	ESSA facilitation, participants contributing
4:15	**Recap of Day 1**	ESSA summary
4:30	Adjourn	

Day 2

Approx time	Topic	Contributors
8:00	Arrival	
8:30	***Overview of agenda***	ESSA
8:40	**Options under consideration (continued)**	ESSA facilitation, participants contributing
10:00	Break	
10:20	**Sub-group discussion on test fishery portfolio**	Sub-group work, supported by ESSA facilitation
11:30	**Sub-group check in**	Sub-group reporting out
12:00	Lunch (provided)	
1:00	**Sub-group discussion on test fishery portfolio (continued)**	Sub-group work, supported by ESSA facilitation
2:30	Break	
3:00	**Sub-group reporting back**	Sub-group reporting out
4:00	**Recap, next steps, and closing remarks**	ESSA summary, panel chairs
4:30	Adjourn	

Appendix B: List of Workshop Participants

Participant	Affiliation
Aaron Dufault	FRPTC
Ann-Marie Huang	FRPTC (Technical Committee)
Bob Conrad	FRPTC
Bob Kehoe	FRP (US industry)
Brendan Connors	ESSA (observer)
Brent McCallum	FRP(Canada recreational)
Brian Assu	PSC Commissioner
Carmen McConnell	DFO
Catherine Michielsens	Pacific Salmon Commission
Chris Ashton	FRP (Canada Purse Seine)
Chris Cue	Canada Industry
Jack Giard	FRP (US reefnet)
James Dixon	FRP (NOAA)
Jamie Scroggie	FRPTC
Jennifer Nener	FRP (Chair, DFO)
John Field	PSC (observer)
Keith Forrest	Pacific Salmon Commission
Kelsey Campbell	Observer
Kirt Hughes	FRP (WDFW)
Les Jantz	FRP (DFO)
Les Rombough	FRP (Canada Gillnet)
Lorraine Loomis	FRP (Vice Chair, US Treaty Tribes
Marcel Shepert	FRP (Canada First Nations)
Mike Griswold	FRP (Canada troll)
Mike Hawkshaw	DFO
Mike Lapointe	Pacific Salmon Commission
Mike Staley	FRPTC
Peggy Mundy	FRP, NOAA Federal
Pieter Van Will	DFO
Ron Goruk	FRPTC
Tiffany Petersen	Makah Tribe
Alex Hall	ESSA (facilitator)
Marc Nelitz	ESSA (facilitator)

Appendix C: Participant Suggestions and Test Fishery Options to Consider from Pre-Workshop Survey and Workshop Discussions

These suggestions come from workshop participants both through pre-workshop input and workshop discussions. The pre-workshop input was predominantly drawn from survey responses about perceived weaknesses with the existing TF program and/or concerns about potentially modifying it, rather than being explicit proposals for alternative TFs options. However, the concepts from the two alternative TFs that were submitted using the template are also incorporated below.

Early qualitative indicators (seaward of marine fisheries)

- Early warning test fishery (e.g., QCI troll)
- Add more seaward TFs
- Data from northern/Alaska fisheries

Improved quantitative indicators

- Adaptability/flexibility to do test fishing outside prescribed pattern
- Test fishery on US side of outer Strait of Juan de Fuca
- Use A13 FSC (or other) fisheries for info on migration behaviour
- Greater utilization of FSC fisheries data
- Test fishery above Thompson River (in some years)
- Provide a minimum TAC every year to allow assessment fisheries
- Add an independent TF near the Area 20 purse seine
- Increase the sets/day in northern/southern purse seine TFs
- Other openings to augment data
    - Better estimate of abundance earlier?
    - Improves daily abundance not total abundance
- Area D 10-boat assessment fishery in 2000s
- Assessment fisheries (i.e., commercial) need to occur every year (regardless of how small) to augment test fishing data
- Use catch [?] from Cdn ITQ purse seine fishery in abundance modeling
- Use FSC catch in abundance model (timely catch reporting)
- Need to find a way for First Nations [?] to use FSC fish as part of assessment [?]
    - Need to have a First Nations liaison function to be able to coordinate between FN communities and PSC
- Develop well managed, systematic FSC test fisheries
    - Reduced mortality through transfer of test catch to FSC, potential reduced cost

Alternate technologies / hydro-acoustic supplement to Mission

- Hydro-acoustic monitoring in Johnstone Strait
- Incorporate juvenile PIT-tagging for few key systems
- Fish finder technologies? Surveys? Combined with sampling (e.g., D. Levy's work 30 years ago)

Data analysis strategies

- Gaming with alternative TF scenarios
- Marine tracking of migration (i.e., from seaward fisheries)

Other

- Reduce or stop TFs that are only collecting qualitative information
- Tag fish and assess harvest – tool to inform stock assessment

Attachment C: Summary of Potential Refinements from Workshop #1

Test Fishery	Refinement	Type of Refinement					Assumptions and/or Conditions	Rationale (where given)	Scen. (†)
		Timing	Effort	Drop	Move	New			
ALL	Delay start of TFs	⇩						protect Early Stuarts / Early Summers	1,2,3
ALL	Finish TFs earlier	⇩							3
ALL	Intensify TFs as run builds, then reduce once peak confirmed	⇧⇩	⇧⇩					Shift effort to when it's most appropriate. Maximize precision	2
ALL	Extend GNs and delay PSs	⇧⇩					In low abundance years		3
Area 12 and Area 20	Adjust TFs based on diversion rate - if NDR is high, maintain A12 and end A20 early (and vice versa) at the end of the run or few days after peak	⇩					Only for sockeye years. Except in Chilko scenario		2,3
Area 20 GN	Start later in low Early Stuart years	⇩					Low Early Stuart		2,3
Area 20 PS	Be more flexible on ending date	⇩							3
Area 12 and Area 13	*Be more flexible on ending date of* A12/13 purse seines	⇩					*If past peak abundance*		3
Area 12 GN (Naka Cr)	Start a few days prior to comm. opening	~							1
Area 4B/5 GN	Start a few days prior to comm. opening	~							1,2
Area 7 Reefnet	Start a few days prior to comm. opening	~							1,2,3
Area 12 GN (Naka Cr)	Expand dates	⇧					If decision to replace Area 12 GN (Round Island)		2
Whonnock GN	Extend duration of TF	⇧						To cover full Pink migration (minor in some years)	2
Area 20 GN	Reduce to 1 GN boat		⇩						2,3
Area 20 PS	Add 2nd seine boat closer to Area 19		⇧					Validate Area 20	1
Area 12 and Area 13	Increase effort		⇧					Reduce variability in estimates	2
Area 12 PS	Add flexibility for additional sets and/or to move Area 12 PS boat to Area 13		⇧		⇄		When lack of consistency among FSC fisheries, A12 TF and A13		1,3
Area 13 PS	Add another Area 13 boat		⇧				When conflicting information from FSC fisheries & Area 12 test fishing		3
Area 12 and Area 13	Alternate 2 boats in A12 PS; 1 boat in A13 PS		⇩						2
Whonnock GN	Increase sample size		⇧				If possible		3
Purse Seines	Remove A20, A12, A13 purse seine TFs			✖			When confident about low/no Chilko SK (i.e., not expecting any intl TAC)		3
Area 12 GN (Round Island)	Remove TF (move TF to Naka Creek, or replace with Rollery Bay GN)			✖	⇄	✓ TF			1,3
Area 12 GN (Naka Cr)	Remove TF			✖			If replaced by TF seaward of Area 12, or, if decision NOT to replace Area 12 GN (Round Island)	Not used for run size estimates	1,2,3
Area 29 Gulf Troll	Remove TF			✖			Consider potential substitution	Not needed/ can't use data in low abundance years	1,2,3
In-river TFs	Amalgamate / reduce redundancies			✖			Depends on conclusions about redundance and feasibility of reducing		3
Cottonwood GN	Remove TF			✖			Potentially with replacement by FSC data	Expect higher sample size at Whonnock with greater abundance, therefore less need for Cottonwood	2,3
Whonnock GN	Remove TF (replace with hybrid Albion TF)			✖			Depending on Mission status; Explore use of data & fish from		3
Qualark	Remove TF (in low abundance)			✖			In low abundance years, pending conclusions of hydro-acoustics		3
Area 4B/5 GN	Remove TF			✖			In low abundance years. Maintain only 1 TF in Areas 4B/5 and Area 7	Don't need in low abundance yrs; C&S gives estimate prior to comm. opening; Only need 1 TF in Areas 4B/5 and 7	3
Area 7 Reefnet	Remove TF			✖			If no US TAC: Maintain only 1 TF in Areas 4B/5 and Area 7	Don't need TF if no TAC; not used for abundance; ; Only need 1 TF in Areas 4B/5 and 7	3
Area 29 Gulf Troll	Add mobile sonar surveys					✓ sonar	On both marine approaches		2
New / Non-existing	Add Gordon Group TF (GN or PS)					✓ TF		More seaward info	1,2,3
New / Non-existing	Add Roller Bay GN TF					✓ TF		More seaward info	1,3
New / Non-existing	Add Cape Caution TF					✓ TF		More seaward info	1
New / Non-existing	Add Area 2W troll TF					✓ TF		More seaward info	1
New / Non-existing	Add in-river TF above Hell's Gate					✓ TF			1,3
New / Non-existing	Add Area 13 sonar (e.g., Cape Mudge)					✓ sonar			2,3
New / Non-existing	Increase flexibility to add test fisheries in 4B/5/6C/6					✓ TF			1
New / Non-existing	Deploy vessel for systematic observation					✓ TF	When in doubt, needing confirmation		2
New / Non-existing	Utilize US CPUE and/or Cdn ITQ CPUE					✓ data		Look at data & usefulness in assessing Pink and Sockeye	1,2
New / Non-existing	Utilize FSC data PS & GN (e.g., A12 / A13 / Johnst. Strait)					✓ data	Whether or not fishing Area 13 TF boat		1,3
New / Non-existing	Add "full fleet TF" or small Area B fishery to assess pinks					✓ fishery	Would need sockeye TAC	To assess Pinks	2
New / Non-existing	Deploy assessment fishery (like Area E TFs)					✓ fishery		to increase sample sizes used for stock identification	2
New / Non-existing	Add small intense fishery opening in gulf					✓ fishery		To assess "standing stock" in gulf	2

† Scenario (from Workshop #1): 1 = High abundance SK, non Pink year; 2 = moderate abundance SK, Pink year; 3 = low abundance SK, non Pink year

Attachment D: Overview of Findings from Research Activities

Table 5: Summary of the subset of refinements from workshop #1 evaluated during this review. Number and letter annotations (in brackets) relate to the activity numbers presented in Section 3.1 and can be used to cross-reference to the summaries of research activities in Section 3.2 and Attachment E.

Potential refinements to test fishery program	Performance criteria									
	Value of information				Financial		Fish mortality		Feasibility	Critical assumptions
	Type of information	Timing of information	Quality of information	Relevance to FRP decisions	Implementation cost	Revenue from sampled fish	Target species	Non-target species		
Use existing Fraser sockeye catch data from Alaska (District 104) or Area 2W (west coast Haida Gwaii) fishery to get earlier information on run size and timing (#4A)	Run size and timing.	Limited ability to provide an earlier indication of timing given that the peak timing of the seaward data may be similar or later than timing observed in Area 12/20.	District 104 data and Area 2W data cannot be used to predict the run size and timing given the lack of a correlation with Fraser River data	High relevance.	Additional cost due to in-season analysis of the stock-ID information.	Not applicable.	No change.	No change.	Low feasibility. Stock-ID information needs to be made available in-season (4-5 days after collection). The fishery in area 2W has not operated in recent years and is unlikely to occur in the future.	Migration rates between D104 and Johnstone Straits must be assumed for intra-annual correlations. These may vary by year, stock and ocean conditions.
Use Fraser sockeye catch data from a new test fishery in the Gordon Group to get earlier information on run size and timing (#4B)	Daily abundance and run size.	Provide information 2 days earlier than currently available.	Existing data suggest it can be used to provide a weak qualitative prediction of abundances in Area 12 two days later. Quantitatively, it can provide estimates of daily abundance but those are more biased (negative) and less precise than estimates based on Area 12 test fishery data. Improvements to in-season run size estimates using these data are predicted to be negligible.	High relevance.	Higher cost.	Higher revenues.	Higher mortality.	Higher mortality.	Limited to years when fishery operates. Requires in-season stock ID information and continued operation of this fishery (FSC)	Assumes that the limited information from 2 years of test fishery data (2005 and 2006) that informed the quality of information is representative of other years.
Supplement existing test fisheries in Area 12 with FSC fishery information from the Gordon Group to improve in-season estimates of run size and timing (#4B)	Daily abundance and run size.	Provide information 2 days earlier than currently available.	Average CPUE from FSC fisheries is a poor predictor of daily abundance in Area 12 since it is two days later and because of the low quality of the data compared to Area 12 test fishery data it cannot be used for run size assessments.	High relevance.	Cost neutral.	Not applicable.	No change.	No change.	Requires information from the fishery to be provided in real time in-season. FSC fishery data is only available in years when fishery occurs.	Extremely limited information upon which to evaluate the quality of information.
Deploy a marine hydro-acoustics at Chatham Point to improve timing and quality of run size (#4C)	Daily abundance, run size and timing	No change	If the quality would be the same as in-river (unlikely), then marine hydro-acoustic estimates would improve the run size by an average of 10% and 5% when evaluated 3 and 6 days after the peak of the run.	High relevance	Higher cost both during the R&D phase and afterwards as a test fishery is still needed to obtain species and stock ID information	Higher revenues if harvest from supporting test fishery was landed and sold, but those revenues would be unlikely to cover costs.	Higher mortality would occur from fish sampled in the supporting test fishery.	Higher mortality would occur from fish sampled in the supporting test fishery.	Low feasibility. It is unclear whether substantial R&D would be supported or justifiable based on 2007 SEF study.	The best case scenario assumes that the quality of the hydro-acoustic data collected at Chatham point is the same as at Mission.
Remove or reduce effort at Naka Creek test fishery (#5A)	Daily abundance, run size and timing	1-2 days less seaward than Round Island test fishery and similar to the Area 12 purse seine test fishery	Given existing data, there is no indication that estimates of daily abundance generated from Naka Creek CPUE are better than those based on CPUE at Round Island. Removing the Naka Creek test	Currently only relevant for qualitative assessments of daily abundance	Lower cost	Lower revenue	Lower mortality	Lower mortality	Possible, but requires commitment to operate this test fishery for longer periods than previously done. A complete analysis of the relevant stock ID sample would permit a more complete evaluation.	The limited available data restricts conclusions from the evaluation (CPUE typically available for about 10 days per year, with 1 or

Potential refinements to test fishery program	Performance criteria									
	Value of information				Financial		Fish mortality		Feasibility	Critical assumptions
	Type of information	Timing of information	Quality of information	Relevance to FRP decisions	Implementation cost	Revenue from sampled fish	Target species	Non-target species		
			fishery does not negatively impact daily abundance, run size or timing estimates.	and fisheries planning. Naka Creek CPUE has provided better predictions of subsequent commercial catches than Round Island.						2 samples analyzed for stock ID).
Remove or reduce Round Island test fishery (#5A)	Daily abundance, run size and timing	Delay the assessment of daily abundances by about 2 days until the stocks are assessed in Area 12 purse seine test fishery.	In-season run size and timing estimates of Early Summer- and Summer-run would be incomplete unless purse seine test fisheries were extended to cover these periods early in the season. Diversion rates would be similarly impacted.	High relevance	Lower cost unless purse seine test fisheries are extended to cover the period when gillnet data are not available.	Lower revenue	Lower mortality	Lower mortality	Possible, if purse seine test fisheries were extended to cover periods when gillnet data are not available, but the relative catchability of gillnet and purse seine early in the season requires quantification.	Assumes data on marine abundance in the area can be obtained from other sources.
Remove or reduce Area 13 test fishery (#5B)	Daily abundance, run size and timing	No change relative to existing alternate test fisheries.	This would reduce the precision of the daily abundance estimates. For most years excluding area 13 does not impact in-season run size estimates, except for some of the low abundance years.	High relevance	Lower cost	Lower revenue	Lower mortality	Lower mortality	Possible, if decreased precision in the daily abundance estimates is deemed acceptable. In addition, it may be difficult to anticipate when abundances are going to be high or low based on pre-season forecasts.	Assumes data on marine abundance in the area can be obtained from other sources.
Adjust test fishery assessment set locations in Area 12/13 to improve in-season estimates of daily abundance and run size (#6A)	Daily abundance and run size.	No change.	Excluding the catches from a few locations used to estimate the mean daily CPUE would increase the precision of the estimate. But the increase in precision does not improve resulting abundance estimates.	High relevance.	Neutral if the removed sets are substituted by sets at other locations, but higher costs if additional sets must be made to compensate for not including some of the sets in the average.	Not applicable. Assumes daily sample size would be unaffected.	No change if same number of sets are made. Higher if more sets are made, costs increase and fish are killed to offset these costs.	No change if same number of sets are made. Higher if more sets are made, costs increase and fish are killed to offset these costs.	Feasible if either not having information from excluded sets or costs of additional sets is acceptable	Assumes historic sockeye migration routes and distribution within Area 12/13 area are stable across years.
Supplement existing test fisheries in Areas 12 and 13 with ITQ fishery information to improve in-season estimates of daily abundance and run size (#6B)	Daily abundance and run size.	Delay in the in-season reporting of all the log-book data from the entire ITQ fleet may limit the timeliness in-season.	Improvement to daily abundance estimates as the average CPUE from ITQ fishery is more strongly correlated with daily abundance than test fishery CPUE. The lack of similar data in Juan de Fuca Strait limits improvements in total run size estimates,	High relevance.	Cost neutral.	Not applicable.	No change.	No change.	Availability limited to years when ITQ fishery operates. Full logbook data are not currently available real time in-season. A separate catchability estimate would need to be derived before Area 12 ITQ	Assumes that the limited information from 2 years of ITQ fisheries (2010 and 2014) is representative of other years.

Potential refinements to test fishery program	Performance criteria									
	Value of information				Financial		Fish mortality		Feasibility	Critical assumptions
	Type of information	Timing of information	Quality of information	Relevance to FRP decisions	Implementation cost	Revenue from sampled fish	Target species	Non-target species		
									data could be used in-season.	
Reduce the number of boats fishing in Area 20 from 1 to 2 boats (#6C)	Daily abundance, run size and timing	No change	Limited impact on bias and precision of predicted daily abundance estimates when underlying abundance are low, but possibly a directional bias on predicted daily abundances depending on the choice of participating test fishermen when underlying abundance is high.	High relevance	Lower cost but not half	No change	No change	No change	Possible but difficult to anticipate when abundances are going to be high or low based on pre-season forecasts. The reduced number of fishing days for individual boats will make it less desirable for test fishermen to participate in this test fishery. Operating only one vessel per night increases the safety hazard associated with participation in this test fishery.	Not possible to analyze the impact of the interaction between the two boats. Anticipation of when underlying abundances are high or low.
Drop Cottonwood from in-river test fisheries (#7)	Lower Fraser sockeye stock ID and CPUE data obtained 1-2 days downstream of Mission. Pitt River and early entry late-run Stock ID and CPUE data. Multi-panel gillnet mesh sizes target sockeye body sizes	Use of Whonnock or Albion would delay information by 1 day relative to Cottonwood	Reduced sample sizes for SID used to estimate escapement by stock and no in-river samples for assessing Pitt and early entry of late-run sockeye.	Medium-high relevance	Lower cost	Lower revenue	Reduced catch	Reduced catch	Requires additional analyses to assess the impact of dropping the program on in-season management, the development of mitigative measures, and the potential need for calibration of the proposed substitute.	Assumes stock ID information, Pitt run size and early entry of late-run data can be obtained from other sources.
Drop Whonnock from in-river test fisheries (#7)	Lower Fraser sockeye SID and CPUE data downstream of Mission. Species composition used for Mission escapement estimates. Estimates sockeye abundance during periods when pink migration predominates. Multi-panel gillnet mesh sizes target all salmonid body sizes.	Timing of information would not be impacted if a mitigative program could be developed to estimate species proportions and provide stock ID samples.	Reduced sample sizes for stock ID used to estimate escapement by stock and inability to estimate species composition needed to estimate daily passage of sockeye salmon in the lower Fraser.	High relevance	Lower cost	Lower revenue	Reduced catch	Reduced catch	Requires additional analyses to assess the impact of dropping the program on in-season management development of mitigative measures, and the potential need for calibration of the proposed substitute.	Assumes SID samples, CPUE and species composition data can be obtained from other sources, particularly early and late during the sockeye migration.
Drop Albion from in-river test fisheries (#7)	Lower Fraser River chinook and chum SID and CPUE data. Multi-panel gillnet mesh sizes target chinook and chum body sizes	Timing of information would not be impacted if a mitigative program could be developed to provide lower Fraser chinook and chum SID and CPUE data.	Inability to estimate lower Fraser chinook and chum abundances and stock proportions.	Low relevance	Lower cost	Lower revenue	Reduced catch	Reduced catch	Requires additional analyses to assess impact of dropping the program on in-season management development of mitigative measures, and \potential need for calibration of the proposed substitute.	Assumes SID samples and CPUE can be obtained from other sources.

Potential refinements to test fishery program	Performance criteria									
	Value of information				Financial		Fish mortality		Feasibility	Critical assumptions
	Type of information	Timing of information	Quality of information	Relevance to FRP decisions	Implementation cost	Revenue from sampled fish	Target species	Non-target species		
Reduce effort at Albion from in-river test fisheries (#7)	Lower Fraser River chinook and chum SID and CPUE data. Multi-panel gillnet mesh sizes target chinook and chum body sizes	Timing of information would not be impacted if a mitigative program could be developed to provide lower Fraser chinook and chum stock ID and CPUE data.	Inability estimate lower Fraser chinook and chum abundances and stock proportions.	Low relevance	Lower cost	Lower revenue	Reduced catch	Reduced catch	Requires additional analyses to assess the impact of dropping the program on in-season management, development of mitigative measures, and the potential need for calibration of the proposed substitute.	Assumes SID samples and CPUE data can be obtained from other sources.
Drop Qualark from in-river test fisheries (#7)	Upper Fraser sockeye SID and CPUE data. Species composition used for escapement estimates that provide independent confirmation of lower river sockeye passage estimates. Gillnets with different mesh sizes target various salmonid body sizes.	Qualark escapement estimates correspond to Mission estimates 3 days prior. Any estimates further downstream would be timelier from a management decision perspective.	Lack of independent validation of lower river estimates for the subset of sockeye stocks that migrate past both sites.	Low relevance	Lower cost	Lower revenue	Reduced catch	Reduced catch	Subject to recommendations by Commission's Fraser River Strategic Review Committee	Is linked to need for second acoustic site.
Remove the reefnet test fishery or reduce the number of days or test fishing locations in area 7 (Forrest 2012)	Daily abundance and expected catches in US Panel Area Waters	Available 3 days after the Area 20 test fishery data	Highly susceptible to environmental conditions. Across years, CPUE from reef net test fisheries is a poor predictor of daily abundance. Of the reef net locations, Lummi Island CPUE provides the best indicator of daily abundance.	High relevance.	Reduced revenue.	Reduced cost.	No change.	Limited change because of the low encounter rates of non-target species.	Feasible to remove the reefnet test fishery if not having qualitative information on salmon in US Panel Area Waters is acceptable. Feasible to restrict the reefnet locations to Lummi Island.	The analysis did not evaluate the relevance of reefnet data to predict US catches.
Increase the number of sets conducted in marine purse seine test fisheries (from 6 to 30; 30 sets would be 5 boats at 6 sets/boat) (Gazey 2001)	Daily abundance, run size and timing	No change	Additional sets (3-5 boats) will improve the precision of the average CPUE but the assumed catchability will have a larger impact on the quality of the daily abundance estimates. Additional sets only generate small improvement in-season run size estimates (the largest improvement being 3-10% for in-season run size estimates for Late-run)	High relevance	Higher	Higher	Higher mortality	Higher mortality	Possible but would require commitment to cover the cost of additional sets and/or boats.	The method assumed daily abundances for area 12 and 20 to be independent.

Attachment E: Detailed Summary of Research Activities

How do various groups use the TF data for other purposes outside the primary, Panel-agreed purposes and functions of the test fishery program? (Activity #2)

Problem context:

The Pacific Salmon Commission and Fraser River Panel want to better understand other ways in which test fishery data are used by various groups. See emphasis of this activity illustrated in Table 6.

Table 6: Illustration of alternative purposes and sources of test fisheries information, with an emphasis of this research activity on understanding other uses of Panel approved test fisheries.

	Panel-agreed purposes of TF program	Other uses of data
Panel-approved TFs	Existing program and processes	**Emphasis of this activity**
Other non-panel information (e.g., new TFs)	Other research activities	Outside scope of Panel

Methods:

We deployed an online survey of a cross-section of users experienced with the test fishery program. The survey focused on gathering a breadth vs. depth of information – it was high-level, relatively short and distributed to 50 people. Survey respondents were asked:

1. "What information outputs from the PSC do you use?"
2. "From which Panel-approved TFs do you directly use data?"

For each individual TF selected we asked:

3. "What data do you use from this TF?"
4. "How are these data useful? What information do they provide?"
5. "When do you use the data from this TF?" (in-/post-season)
6. "How often do you use the data from this TF?"

In support of Q1 and Q2, we also briefly examined web traffic to the PSC website.

The survey received 26 responses – 24 complete; 20 with information on the use of TF data (#2-6 above). Respondents were from the commercial sector, First Nations, government, test fishers, and the PSC (plus 7 who did not provide an affiliation).

Caveats: The following information is based on an opportunistic sample. It provides a qualitative indication of ways in which the TF data are used. However, the survey results do not necessarily provide a representative sample of users, so we cannot: (1) conduct quantitative analyses on the results, (2) conclude that a lack of mention means a lack of use, or (3) make conclusions about the extent of use or the value of these TF data.

Key findings:

Use of PSC Information Products[11]: These products are widely used and most respondents use three or more of them (20 respondents use 3+). A few people only use the data products. Web traffic data was only available from September (due to website upgrade) – the most popular downloads were the daily TF results (1491), Whonnock GN (1106), and the annual TF summary (569). Next year it will be possible to track web traffic through the fishing season.

Use of Data from Test Fisheries: The number of respondents that use data directly from an individual TF ranged from 3 (Gulf Troll) to 15 (Area 20 GN), out of the 20 that use TF data (see Figure 4). For all of the TFs other than Qualark, 100% of the respondents that use a TF use the data in-season, and 14-40% of those respondents also use the data post-season. For Qualark, 80% of respondents use the data in-season[12] and 60% use them post-season. Respondents reported using the catch and effort data for all twelve TFs in terms of sockeye, ten TFs for pinks (i.e., excludes Gulf Troll, Naka GN), and for six TFs for other salmon species (i.e., A20 GN, A20 PS, A12 GN, A12 PS, A13 PS, Qualark).

Many of the responses and comments regarding use of the TF data confirmed the Panel-agreed purposes and functions of the TF program (e.g., the need to understand stock size and timing to inform management decisions) and the contribution of individual TFs to the estimation of aggregate characteristics (e.g., abundance, timing, spread, and diversion of run by management group). Respondents further indicated how certain TFs are useful for providing: (1) qualitative indicators or presence and/or movement through certain areas, (2) confirmation or verification of other TF results, (3) delay behaviour of late run fish, (4) biometrics information on sampled fish, and (5) verification of expansion lines. However, these uses are essentially established aspects of the test fishery program and thus do not constitute other, alternative uses *outside* of the program. Also some of this information comes from further processing / sampling conducted by PSC and is not directly available in daily TF data.

Table 4 summarizes ways in which the data from the TF are being used that could be considered as "other" or "alternative" ways in which the data from individual TFs are being used (though the first two columns are implicitly part of the TF program).

Implications on refinements to test fishery program:

When considering potential modifications to the existing TF program, it is important to understand where TF data are being used for other, alternative purposes outside of the Panel-agreed purposes. Even if these additional, external benefits are not explicitly incorporated into Panel decisions about the structure of the TF program, it is valuable to understand the broader suite of benefits.

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[11] This includes: daily test fishing reports; Fraser River Panel weekly reports; Fraser River Panel regulatory announcements; Sockeye and Pink salmon in-season status reports; and, Fraser River Mission escapement reports.

[12] Note that the PSC assessment program does not use data from the Qualark TF in-season.

Do Southeast Alaska District 104 and Area 2W fisheries inform in-season estimates of Fraser sockeye run size and run-timing? (Activity #4A)

Problem context:

Fisheries that are more seaward of current test fisheries have the potential to provide more timely information on the size and timing of Fraser sockeye returns than existing test fisheries. Two potential sources of such information that have been identified in the past are:

- District 104 (D104) purse seine fisheries at Noyes Island in Southeast Alaska
- Troll fisheries in Area 2W (West Coast Haida Gwaii)

The analyses described here seek to answer the following specific questions:

- Are estimates of Fraser sockeye timing in D104 or Area 2W positively correlated with Fraser River sockeye timing in Areas 13 and 20?
- Can timing estimates from fisheries in D104 or Area 2W be used in-season to predict the timing in Areas 13 and 20 (i.e., is peak Fraser sockeye run-timing earlier in D104 or Area 2W than in Areas 13 and 20?)?
- Are estimates of Fraser sockeye run size in D104 or Area 2W positively correlated with Fraser River sockeye run size?

Methods:

Data:

- Weekly estimates of effort, total sockeye catch, and Fraser sockeye catch for the D104 purse seine fishery from 1982 to 2016[13].
- Total Fraser sockeye run size and timing estimates from 1982 to 2016.
- No data were available from the Area 2W troll fishery but a memo produced in 1997 was re-examined (PSC 1997).

Analyses:

- Related Fraser sockeye run-timing in D104 derived from CPUE[14] data to run-timing in Areas 13 and 20. Timing in D104 was defined as the week when 50% of the total CPUE had been reached and timing in Areas 13 and 20 was defined as the day when 50% of the run had migrated through Areas 13 and 20.
- Related CPUE data for Fraser sockeye in D104 to total reconstructed run size in Areas 13 and 20.
- The natural-log transform ($\log_e$) was applied to the dependent and independent variables in the run size analysis because observations of abundance are log-normally distributed.

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[13] Provided by the PSC Northern Boundary technical committee.

[14] CPUE is defined as catch per purse seine set throughout this memo.

Key findings:

District 104:

- D104 Fraser sockeye timing is not correlated with Area 13 and 20 timing. Though there are some years where D104 timing is earlier than Area 13 and 20 timing (e.g., by 1-2 weeks) there are many other years where it is the same or even later (Figure 8a).
- D104 CPUE is not correlated with Fraser run size (Figure 8b).

Area 2W:

- While Area 2W catch and timing may be related to actual run timing in some years, there is a strong tendency for peak catches in northern areas to be of fish which are later than the peak of the run on the south coast (PSC 1997).

Implications on refinements to test fishery program:

The lack of a relationship between the timing and abundance of Fraser sockeye observed in D104 and on the south coast of British Columbia suggests that information on Fraser sockeye run-timing and abundance from District 104 is not expected to help inform in-season assessment of Fraser sockeye run-timing and size moving forward.

Given that: (1) the qualitative patterns observed for D104 appear to also hold for the Area 2W fishery (PSC 1997); (2) the Area 2W troll fishery has not operated in recent years on sockeye; and (3) there is unlikely to be an Area 2W troll sockeye fishery in years to come, information on Fraser sockeye from Area 2W is also not expected to help inform in-season assessment of Fraser sockeye run-timing and size moving forward.

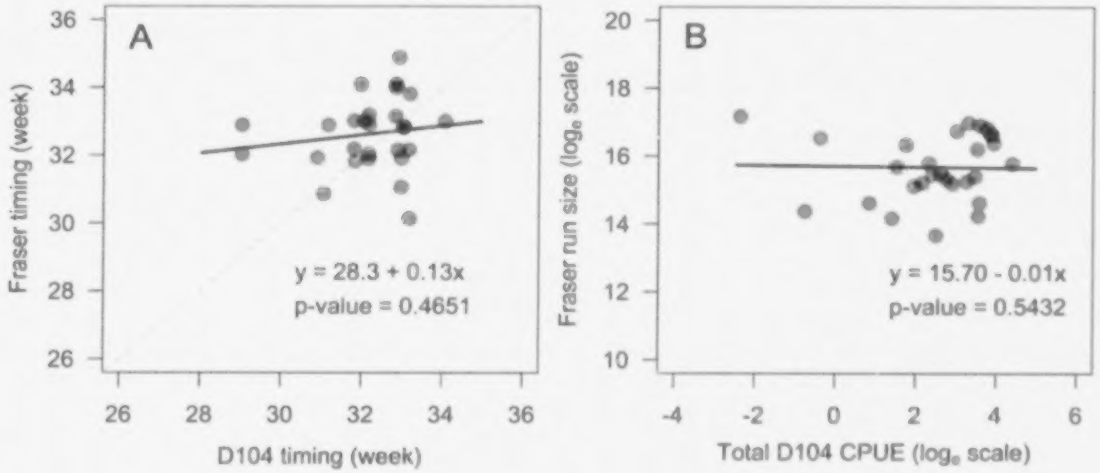

Figure 8: Relationship between peak Fraser sockeye run-timing (A) and run size (B) in District 104 and Areas 20 and 13. For reference, week 30 corresponds to July 17th-24th in 2016.

Can a Gordon Group purse seine test fishery inform in-season estimates of Fraser sockeye run-timing and size? (Activity #4B)

Problem context:

Fisheries that are more seaward of current test fisheries have the potential to provide more timely information on the timing and size of Fraser sockeye returns than existing test fisheries.

In 2005 and 2006 a purse seine test fishery operated in the Gordon Group at the northern end of Area 12, approximately 2-days seaward of existing purse seine test fisheries in Johnstone Strait. An FSC fishery also occurred in the Gordon Group in 2003 and 2004, but at a smaller scale than the 2005-2006 test fishery. It has been suggested that a test fishery at the Gordon Group might serve as an early index of daily abundances and potentially run size, though greater temporal coverage within years and more data across years would be required before this could be rigorously assessed (Cave and Latham 2007). In addition, the strength of the relationship between Gordon Group test fishery CPUE[15] and true sockeye abundance in Area 12 has not been quantified.

The analyses described here seek to answer the following specific questions:

- Does the Gordon Group provide an early indication of the abundance of sockeye that are potentially available for fisheries in Area 12 two days later?
- How representative is Gordon Group CPUE of Area 12 CPUE?
- Are abundances derived from Gordon Group CPUE data correlated with Area 12 daily abundances?

Separately from these analyses, Activity #4C focuses on the use of seaward information for in-season run size assessments and examines whether Area 12 test fishery data could be supplemented with Gordon Group data two days earlier within the in-season run size assessment model to estimate run sizes.

Methods:

Data:

- Fraser sockeye catch per set in the Gordon Group test fishery in 2005 and 2006[16].
- Fraser sockeye catch per set in the Gordon Group FSC fishery in 2003 and 2004[17].
- Fraser sockeye catch per set in the Area 12 and 20 test fisheries from 2003 to 2006.
- Reconstructed Fraser sockeye abundance in Area 12 and 20 from 2003 to 2006.

Analyses:

- Plotted Gordon Group and Areas 12 test fishery CPUE over time to examine extent to which they track each other temporally.

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[15] CPUE is defined as catch per purse seine set throughout this memo.

[16] Provided by Fisheries and Oceans Canada.

[17] For simplicity, the 2003 and 2004 FSC fisheries along with the 2005 and 2006 test fisheries are collectively referred to as "Gordon Group test fisheries" in this document.

- Related Gordon Group CPUE to Area 12 CPUE two days later to quantify the relationship between CPUE from the two test fisheries, and evaluated possible differences in catchability between the two sites.
- Used the ratio of Gordon Group to Area 12 CPUE to generate an Area 12 equivalent CPUE from the Gordon Group data. These Gordon group based CPUE estimates where then used in combination with Area 20 CPUE data to derive an in-season prediction of reconstructed daily abundance and compared to post-season reconstructed daily abundance estimates based on Mission hydro-acoustics plus seaward catches[18].
- Quantified precision (mean percent raw error, MPE) and bias (mean absolute percent error, MAPE) of Gordon Group and test fishery derived daily abundance estimates when compared against post-season reconstructed abundance estimates.
- All analyses were conducted on estimated Summer-run (excluding Harrison) and Early Summer-run CPUE and abundance based on daily estimates of stock composition.
- For brevity, the results presented in the following sections focus on the Summer run and test fisheries in 2005 and 2006. We note those instances when the qualitative patterns differ for the Early Summer run and the FSC coordinated fisheries in 2003 and 2004.
- The natural-log transform ($\log_e$) was applied to the dependent and independent variables in most analyses because observations of abundance are log-normally distributed.

Key findings:

- Gordon Group test fishery CPUE loosely tracks Areas 12 CPUE suggesting that it could potentially inform fishery planning in Area 12 by providing an early qualitative indication of whether daily abundance is increasing or decreasing (Figure 9).
- On average, the catchability at the Gordon Group site is lower than at the current Area 12 purse seine test fishery locations, resulting in lower CPUE (i.e., ~1/3 of Area 12 test fishery CPUE) (Figure 10).
- Using Gordon Group CPUE data to quantitatively predict abundances generates more biased and less precise in-season estimates than Area 12 test fishery data (Figure 11). However, the Gordon Group test fishery does so 2 days earlier.
- Catchability at the Gordon Group site was slightly higher when estimated from the FSC fishery data compared to the test fishery at the Gordon Group (0.5 vs. 0.33), but still lower than at the current Area 12 purse seine test fishery locations.
- Using the Gordon Group FSC CPUE data to quantitatively predict abundances generated more biased and similarly precise in-season estimates compared to those from Area 12 test fisheries in 2003, and more biased and less precise in-season estimates in 2004.
- The above findings were qualitatively unchanged when the Early Summer run was considered instead of the Summer run.

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[18] Area 20 was included in the estimate of reconstructed abundance because solely using Area 12 would confound the comparison of the relationship between a Gordon Group or A12 abundance estimate and true abundance because "true" abundance is estimated in part from the Area 12 CPUE estimates.

Implications on refinements to test fishery program:

The available data suggest that Gordon Group CPUE provides a weak qualitative indication of the abundance of sockeye that are potentially available for fisheries in Area 12 two days later.

The Gordon Group has the potential to provide quantitative in-season estimates of daily abundance approximately 2-days earlier than the current Areas 12 test fishery. However, these estimates are predicted to be more biased (negative) and less precise than in-season estimates derived from Area 12 test fishery CPUE. The potential benefits of earlier information from the Gordon Group should be considered in light of additional analyses (see Activity #4C) that have quantified the influence of additional (and earlier) test fishery data on the in-season assessment of run size estimates.

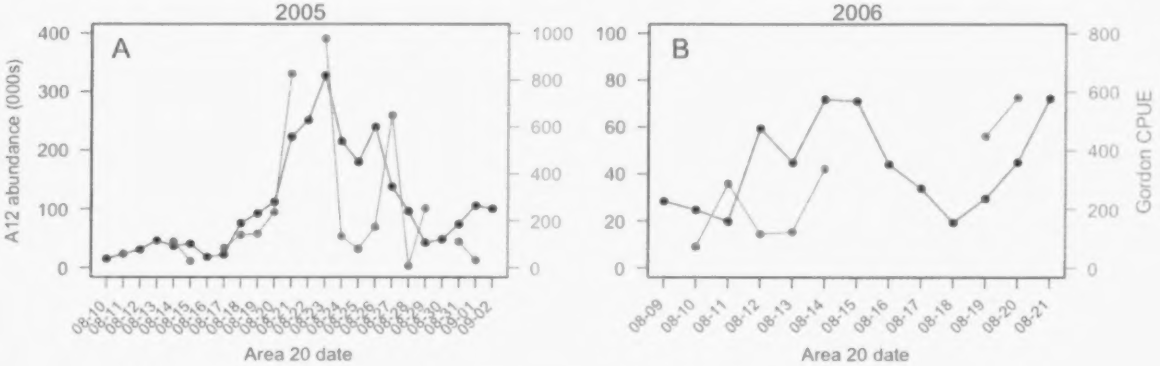

Figure 9: Area 12 and Gordon Group CPUE over time in 2005 (A) and 2006 (B).

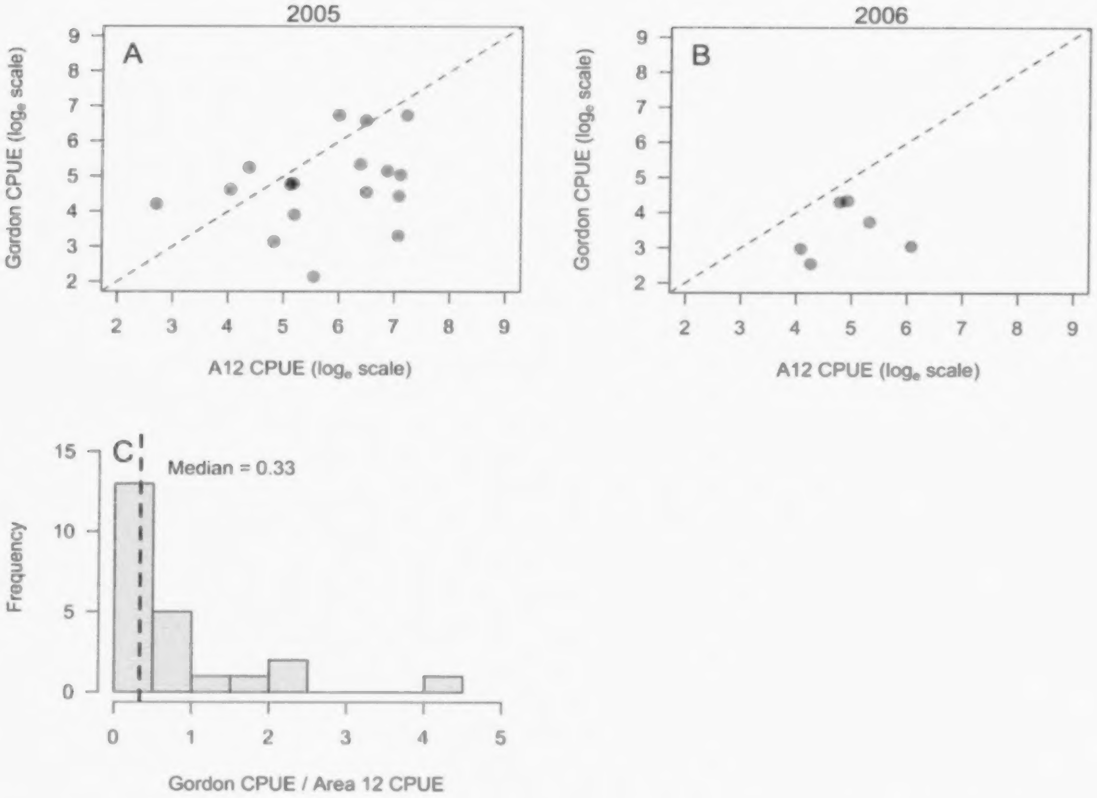

Figure 10: Relationship between Gordon Group and Area 12 CPUE in 2005 (A) and 2006 (B) as well as a histogram of the ratio of Gordon Group to Area 12 CPUE across both years (C). Note Gordon Group CPUE is lagged by 2 days to account for the assumed 2 days it takes sockeye to migrate from the Gordon Group location to the location of the Area 12 test fishery.

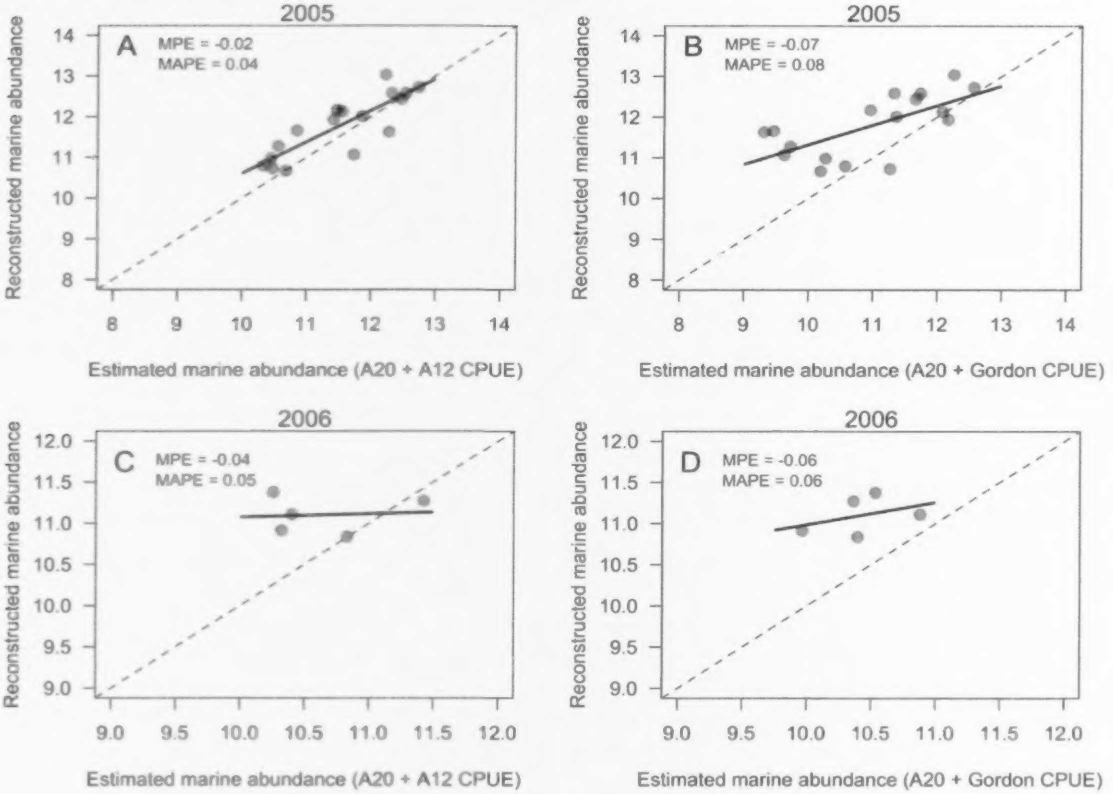

Figure 11: Relationship between estimated sockeye abundance (based on expanded CPUE) and true abundance in Area 12 based on Area 12 and 20 (A and C) or Gordon Group and Area 20 CPUE (B and D). Precision (mean percent raw error, MPE) and bias (mean absolute percent error, MAPE) are provided for each relationship. Note all data are on $\log_e$ scale.

Can the use of seaward information improve quantitative in-season run size assessments or provide useful timing information? (Activity #4C)

Problem context:

Data collected more seaward than at the current test fisheries or hydro-acoustic sites have the potential to provide more timely, quantitative information on the run size and timing of returning Fraser sockeye stocks, provided these data can be incorporated within the current assessment methodology.

The analyses described here seek to:

- Identify the different ways seaward information can be incorporated within the current in-season run-size assessment models.
- Evaluate if the seaward information can improve in-season run size assessments.

Methods:

While data may exist for some seaward fisheries, these data are limited in terms of the number of years as well as the number of days during which data had been collected. In order to avoid blanket statements about the need for more data to properly assess the impact of seaward data, an alternative approach is used here to predict the impact of seaward data on in-season run size assessments assuming the quality of the seaward data is the same as current test fisheries or hydro-acoustic data but with the data being available sooner than currently is the case.

Data:

- Daily estimates of Fraser sockeye CPUE for Summer-run stocks excluding the Harrison River[19] in purse seine test fisheries in Area 12 and 20 from 1998 to 2016.
- Reconstructed daily marine abundance estimates from 1998 to 2016 for Summer-run stocks excluding the Harrison River.

Analyses:

- Compared the precision of the timing estimates for Summer-run stocks excluding the Harrison River obtained from alternative seaward data or earlier timed stocks against the precision of the preseason and in-season timing forecast estimates as well as in-season estimates.
- Conducted retrospective analyses for Summer-run excluding Harrison to evaluate the impact of including seaward data in the in-season assessment model on resulting run-size estimates at different times during the season (i.e., at the peak of the run and 3, 6, and 9 days after the peak of the run).
- To assess the impact of including seaward hydro-acoustic derived abundance data within the assessment, it was assumed that the reconstructed marine abundance estimates derived from the Mission hydro-acoustic data 6 days later represent the seaward hydro-acoustic data, i.e., the time series of reconstructed daily abundances included in the run-size model is extended by 6 days.
- To assess the impact of including seaward test fishery CPUE data within the assessment, it was assumed that the CPUE from the traditional marine test fisheries, collected two days later, represent the seaward CPUE data, i.e. the CPUE time series included in the run-size model is extended by two additional days.

Key findings:

- Seaward information can be quantitatively included in the current assessment methodology by incorporating the information in the prior probability distribution for run size or timing or by fitting the in-season run-size model to the additional time series.
- Improving the quality of the data (using seaward echo-sounding) or the timeliness of the data (using seaward test fisheries) can only improve run-size estimates to a certain extent. The performance of the run-size model will depend to a larger extent on how well the model is able to predict abundances seaward of the test fisheries.

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[19] Data for stocks bound for Harrison River and Widgeon Slough were excluded because these stock may hold in Georgia Strait for variable periods prior to migrating upstream to natal spawning areas. This migration delay behavior compromises analyses that relate marine CPUE in to reconstructed abundances.

Using seaward data or timing estimates for earlier-timed stocks to update the run-timing prior:

- Based on the precision of the estimates, the preseason timing forecast is a better predictor of the timing of the run than the timing of non-Fraser stocks (Figure 5A) or the timing obtained from seaward information such as District 104 catches (see Activity #4A). The timing of earlier-timed Early Stuart is a better in-season predictor of the timing compared to the pre-season forecast (Figure 5A).
- When running the in-season run size assessment model 3 days after the peak of the run, the last 6 days of test fishery data provide sufficient information about the peak of the run to update the prior distribution on timing and decrease the uncertainty in the timing estimate (Figure 5B).

Using seaward hydro-acoustic data for run size estimation:

- At the peak of the run (with hydro-acoustic data and echo-sounding data available up to the day before the peak of the run), there is no improvement in the median run size estimate using seaward echo-sounding data (Figure 6A).
- Three days after the peak of the run, using seaward echo-sounding data instead of test fishery data would improve the accuracy of run size estimates by 10% (median) while after 6 days the improvement is reduced to 5% (median, Figure 6A).
- Using hydro-acoustic data instead of test fishery data decreases the uncertainty around the run size estimates (relative inter-quartile range, IQR) (Figure 6B).

Using seaward CPUE data for run size estimation:

- For the majority of the years, in-season run-size estimates do not improve when using seaward CPUE data. Test fishery data seaward of the current test fishery data is only useful (> 10% improvement in run size error) at the peak and 3 days after the peak of the run for 16% of all years (Figure 7A), when the run size uncertainty is very large (Figure 7B).
- For run-size assessments, the main benefit of collecting data at locations seaward of the marine test fisheries does not lie in the 2 additional days of CPUE data but in the collection of an additional independent CPUE time series to improve daily abundance estimates seaward of Mission. But, an independent time series of CPUE in Johnstone Strait could be better collected in Area 13 than seaward of Area 12.

Implications on refinements to test fishery program:

Using seaward data or timing estimates for earlier-timed stocks to update the run-timing prior:

- Because some seaward information is collected for different purposes, these data may not be available on time to be useful for in-season assessments.
- In addition, in-season fisheries-specific stock ID information is needed to improve the usefulness of the seaward information for run size assessment.

Using seaward hydro-acoustic data:

- The value of seaward echo-sounding data for run-size assessment will likely be smaller than indicated by the retrospective analysis, given the larger sampling area and the limited ability to control the sampling environment. Species identification problems may further reduce the accuracy of derived salmon abundance estimates.

- Abundance estimates derived through echo-sounding at Chatham point would only cover part of the run unless similar sampling would take place in Juan de Fuca Strait.
- Marine echo-sounding cannot completely replace test fishing as test fishing catches are needed to obtain stock ID information. Low gillnet catchability later in the season may necessitate more expensive purse seine test fisheries to achieve sample sizes.
- Substantial research and development costs are involved when wanting to implement this seaward assessment strategy.

Using seaward CPUE data:

- The value of seaward CPUE data for run-size assessment will likely be smaller than indicated by the retrospective analysis, because the seaward CPUE data are likely less precise due to the wider sampling area. Lack of stock ID information from seaward test fishing catches would further decrease the value of the seaward data.
- If the catchability of the seaward test fishery differs from Area 12 (as suggested in Activity #4B), data need to be collected to estimate the catchability or assumptions need to be made based on the width of the migration area.
- A second independent time series of CPUE data benefits run size estimation more than seaward assessment (see Activity #5B).

Can data from the Naka Creek gillnet fishery improve in-season estimates of Fraser sockeye abundance and run-size? (Activity #5A)

Problem context:

The Naka Creek gillnet test fishery was conducted for 10 – 12 days per year from 2009 to 2015. Part of the rationale for the Naka Creek test fishery was to have a gillnet test fishery in a lower portion of Johnstone Strait than the Round Island location that could improve assessment of Early Summer run sockeye.

The analyses described here seek to answer the following specific questions:

- How does Round Island gillnet test fishery CPUE compare to Naka Creek gillnet test fishery CPUE?
- How do daily abundance estimates based on CPUE at each site compare to reconstructed daily marine abundances based on Mission passage and relevant catches?
- How does the CPUE of each site, separately and combined, perform in terms of bias and precision when estimating in-season abundance?

Methods:

Data:

- Daily estimates of CPUE for Fraser sockeye excluding Late-run stocks and Harrison, collected in the Naka Creek gillnet test, the Round Island (A12) gillnet fishery and the Area 20 gillnet test fishery from 2009 - 2015.
- Reconstructed daily abundance estimates for Fraser sockeye excluding Late-run stocks and Harrison from 2009 - 2015.

Analyses:

- Related Naka Creek gillnet test fishery CPUE to Round Island gillnet test fishery CPUE data one day earlier, and evaluated possible differences in catchability between the two sites.
- Used the ratio of Naka Creek to Round Island CPUE to generate an Area 12 equivalent CPUE from the Naka Creek data. These Naka Creek based CPUE estimates where then used in combination with Area 20 gillnet CPUE data to derive an in-season prediction of reconstructed daily abundance and compared to post-season reconstructed daily abundance estimates based on Mission hydro-acoustics plus seaward catches. These hydro-acoustic based daily abundances are independent from the test fishery based abundance estimates.
- Compared predicted daily abundances based on historic catchability estimates and CPUE at Round Island or Naka Creek against reconstructed daily abundances for all available years.
- Quantified the bias and precision of abundance estimates based on in-season catchability estimates used in combination with CPUE data collected at Round Island, at Naka Creek, or at both sites.

Key findings:

- Naka Creek CPUE was not correlated with Round Island CPUE (Figure 12A), however, the CPUE at Naka Creek was generally higher than at Round Island (Figure 12B). The median ratio of Naka Creek versus Round Island was 3.5, indicating that Naka Creek catches 3.5 time more sockeye per unit effort, though there was a lot of variability among years.
- Marine abundance estimates based on Round Island and Area 20 CPUE data were more strongly correlated with reconstructed marine abundance estimates than Naka Creek and Area 20 CPUE data for the same days (Figure 13).
- Round Island produced unbiased predictions of in-season abundance, while the average bias using Naka Creek data was 8% (Figure 14A). Using Naka Creek data in combination with Round Island reduced the average bias to 4% (Figure 14A).
- Naka Creek generated abundance estimates with higher precision than when using Round Island (4% difference in precision error) or both data sets combined (Figure 14B) but the benefit of increased precision would be offset by the higher bias when using Naka Creek CPUE.

Implications on refinements to test fishery program:

- Given the higher CPUE at Naka Creek than Round Island, CPUE from Naka Creek would be a better indicator of expected commercial catches in that area. In addition, adding Naka Creek to the current suite of test fisheries would increase the sample size for stock ID in Area 12 during low abundance years, though the representativeness of the samples taken for stock ID at Naka Creek would need to be compared against samples from other test fisheries in the area (e.g. Round Island, Area 12 purse seine).
- Because the CPUE at Naka Creek is not correlated with the CPUE at Round Island and because differences in catchability between the two sites vary substantially from year to year, it is difficult to use historic catchability based on Round Island data in combination with the Naka Creek data to estimate daily abundance.
- Integrating Naka Creek data within the current run size assessment models is possible but would result in little or no improvement in abundance estimates, and seems insufficient to warrant the additional cost of operating the Naka Creek test fishery on a daily basis in future years.
- A Naka Creek specific catchability estimate would be needed to thoroughly evaluate replacing the Round Island test fishery with the Naka Creek test fishery. The Naka Creek test fishery

would therefore need to be run for the full gillnet test fishing period for several years in order to have comparable data available for both sites.

- Logistical issues at Naka Creek, including lack of cell phone communication and remote location, make it difficult to deliver the required DNA and scale samples in a timely manner.

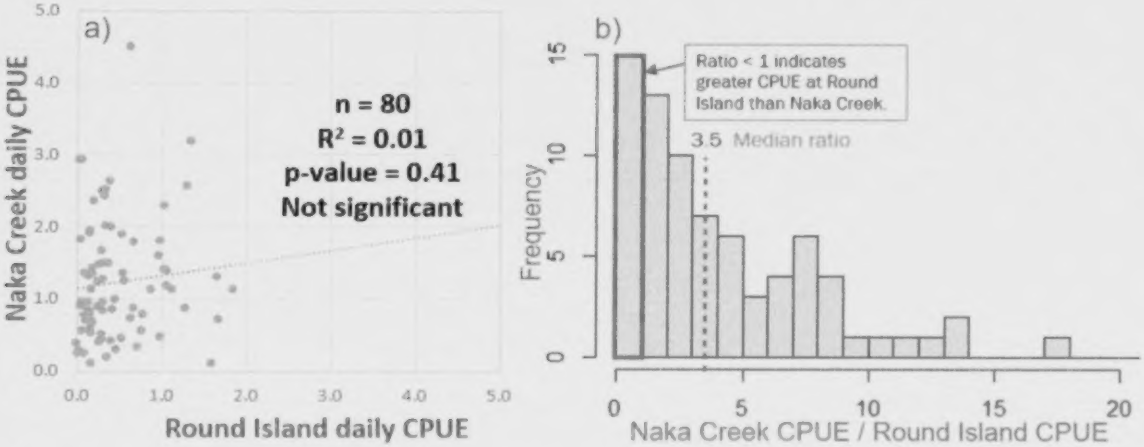

Figure 12: (A) Relationship between gillnet CPUE data collected at Round Island and Naka Creek data collected one day later, and (B) ratio of Naka Creek gillnet test fishery CPUE to the Round Island gillnet test fishery CPUE one day earlier.

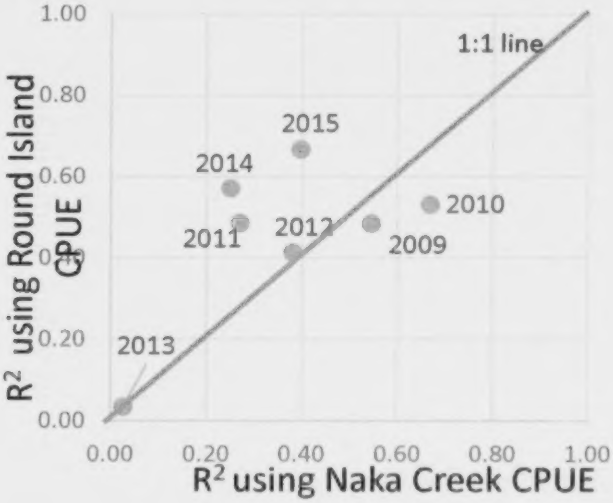

Figure 13: A comparison of the R^2 values calculated when comparing the daily abundance estimates using Naka Creek CPUE versus Round Island CPUE against reconstructed daily abundance estimates in a given year.

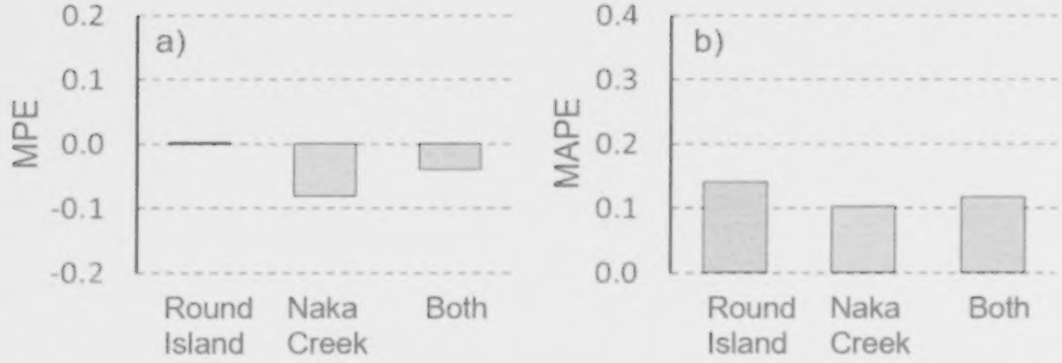

Figure 14: A comparison of (A) bias (mean percent error) and (B) precision (mean absolute percent error) of the in-season abundance estimates produced by using Naka Creek CPUE (when available), Round Island CPUE or both in combination with in-season catchability estimates. Greater error (negative or positive) indicates greater bias or lower precision.

Does the use of Area 13 purse seine test fishery data improve in-season estimates of daily abundance and run size? (Activity #5B)

Problem context:

The Area 13 purse seine test fishery has been operating since 1995. Even though this test fishery is one day less seaward than the Area 12 test fishery, the narrower width of the Strait at this test location improves the catchability of fish. It has been suggested that the potential benefits of using CPUE data from this test fishery to improve in-season assessment of daily abundance and run size should be quantified.

The analyses described here seek to answer the following questions:

- Does the magnitude of the bias and precision of daily abundance estimates change when including Area 13 CPUE data?
- Does including the Area 13 CPUE data within the in-season run size model reduce run size error?

Methods:

Data:

- Daily estimates of Fraser sockeye CPUE for Early Summer-run and Summer-run excluding Harrison in purse seine test fisheries in Area 12, 13 and 20 from 1998 to 2016.
- Reconstructed daily marine abundance estimates from 1998 to 2016 for Early Summer-run and Summer-run excluding Harrison.

Analyses:

- Conducted retrospective analyses for Early Summer-run and Summer excluding Harrison to quantify the impact of averaging abundance estimates derived from Area 12-20 with abundance estimates derived from Area 13-20 against abundance estimates based solely on Area 12-20 or Area 13-20 CPUE data. The resulting daily abundance estimates, 6 day abundance estimates and total run size abundance estimates were compared against the corresponding reconstructed abundance estimates in order to quantify bias and precision.

- Conducted retrospective analyses for Summer-run excluding Harrison to quantify the impact of including Area 13 CPUE data in the in-season assessment model on resulting run size estimates at different times during the season (i.e., at the peak of the run and 3, 6, and 9 days after the peak of the run). Run size errors were evaluated through a comparison of the in-season run size estimates with the post-season reconstructed run size.

Key findings:

- Unlike the daily abundance estimates derived from individual boats in Area 20 (see Activity #6C), the daily abundance estimates derived from the Area 13/20 CPUE data can differ substantially from the daily abundance estimates derived from the Area 12/20 data (Figure 15).
- For Summer-run stocks, using Area 13/20 data to estimate daily abundances instead of Area 12/20 does not impact the precision of the daily abundance estimates but increases the biases in the daily abundance estimates on average by 3%. If the daily abundance estimates from the two data sources are averaged, the correlation between the in-season and post-season daily abundance estimates increases (R^2 becomes 0.5 instead of 0.41). When evaluated over 6 day periods, the correlation between the in-season and post-season daily abundance estimates increases but the impact of including Area 13 diminishes ($R^2=0.68$ for Area 12/20 data and $R^2=0.72$ when averaging abundance estimates derived from Area 12/20 and 13/20 data)
- For Early Summer-run the benefits of the use of Area 13 when producing daily abundance estimates are not as strong (only 0.02 improvement in R^2) and non-existent when evaluating abundances over 6 day periods.
- Using the data within the in-season run size model, for most years there are limited differences in run size when including Area 13 versus relying on area 12/20 CPUE data only and the limited differences can signify decreased as well as increased error in the run size (-10 to +10%) (Figure 16).
- In some years including Area 13 can substantially decrease run size errors in-season (up to 50%). These improvements mainly occur during years with lower run sizes (<2.5 million), where including Area 13 CPUE data within the model provides a stronger signal that abundances are lower than anticipated, but not all low abundance years benefit from Area 13 data.

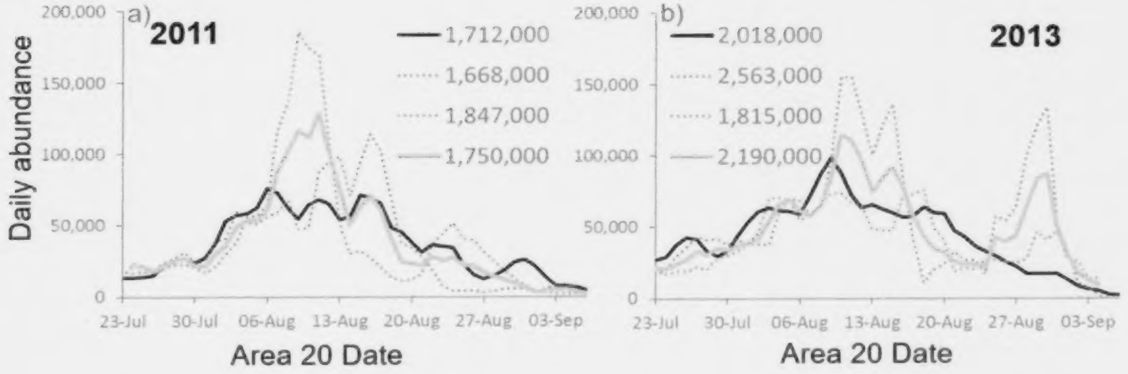

Figure 15: Example using 2 years, to illustrate the difference between the three day moving average of the daily reconstructed abundance of Fraser sockeye excluding Late-run and Harrison (black line), and the 3 day moving average of abundance predictions based on CPUE of both Area 12 and 13 (orange line) or based on Area 12 (broken blue line) and Area 13 (broken pink line) CPUE data separately.

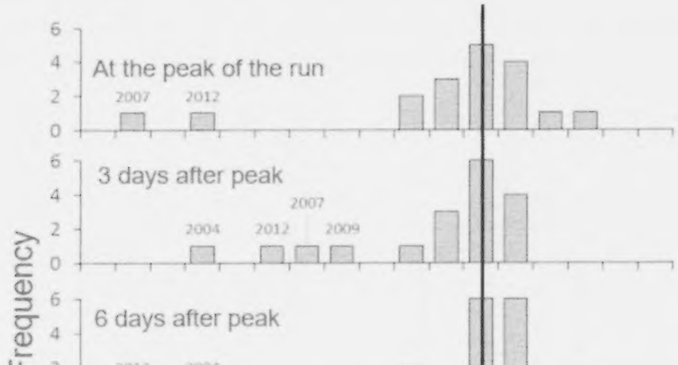

Figure 16: Percent change in run size error at different times during the season (at the peak of the run and 3, 6 or 9 days later) when including Area 13 CPUE data within the in-season run size model versus without these data.

Implications on refinements to test fishery program:

- Catches in the Area 13 purse seine test fishery tend to be higher than in Area 12 due to the narrower width of the Strait in Area 13 and as so Area 13 test fishery data may be better indicator of expected commercial catches in the area than Area 12 test fishery data.
- The Area 13 purse seine test fishery was originally designed to assess Summer- and Late-run migrating sockeye salmon. Averaging the daily abundance estimates derived from Area 13/20 CPUE data with estimates derived from Area 12/20 improves in-season daily abundance estimates but has a lower impact on abundance over 6 day periods. No similar improvements are detected when using Area 13 data for the assessment of Early Summer-run abundance.
- Adding the Area 13 test fishing data within the run-size assessment model is more useful for run-size estimation during low abundance years but this is not necessarily the case for all low abundance years.
- Using uncertain pre-season forecast estimates, it would be difficult to evaluate if Area 13 test fisheries would be useful in a given year, i.e. if the run size is going to be small, especially since its usefulness is associated with confirming indications that run-size estimates may not be as high as expected based on pre-season forecast estimates.

Does an examination of Area 12 and 13 purse seine test fishery set locations reveal opportunities to improve in-season estimates of Fraser sockeye daily abundance? (Activity #6A)

Problem context:

Purse seine test fisheries for Fraser River sockeye currently operate in Areas 12 and 13 from mid-July to late August each year. Approximately 6 assessment sets are conducted on a daily basis at locations within each Area and the average CPUE from these six sets is used in combination with an in-season catchability estimate to produce in-season estimates of daily abundance.

The locations of the test fishery sets were originally selected to be representative of the abundance of migrating sockeye in each Area. However, a quantitative examination of their representativeness had not been conducted.

The analyses described here seek to answer the following specific questions:

- Are sockeye catches at some test fishing locations consistently more biased or variable than others?
- Does including or excluding these test fishing locations reduce bias and increase the precision of average daily CPUE[20] and derived daily abundance estimates for Fraser sockeye?

Methods:

Data:

- Sockeye catch per assessment set in Areas 12 and 13 from 1998-2016.
- Reconstructed Summer-run abundance (excluding Harrison) in Areas 12 and 13 from 1998-2016.

Analyses:

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[20] CPUE is defined as catch per purse seine set throughout this section.

- For each year, we related the catch at individual test fishing locations on a given day to the reconstructed daily abundance estimate at the same location on the same day. Once the relationship between catch per set and daily abundance had been quantified for a given year, we calculated the residuals by comparing the observed catch against the expected catch based on the yearly relationship between catch per set and daily abundance. Using the standardized residuals of individual test fishing locations for subsequent analyses allowed to draw upon all historical years despite the distinct differences in catchability when summarizing the results for individual test fishing locations.
- Quantitatively evaluated the individual test fishing locations by quantifying the bias (mean raw error) and precision (mean absolute error) of the standardized residuals when using catches from these locations to predict daily abundance.
- Plotted average bias vs. average precision for each test fishing site to qualitatively identify whether there are any outliers (i.e., sites that tend to catch fewer, or more, fish than others and as a result produce biased abundance estimates, as well as sites that tend to have more variable catches than others and therefore tend to be less precise when used to produce daily abundance estimates).
- Quantified the difference in average daily CPUE with and without each test fishery location included in the CPUE estimate.
- Quantified whether or not the strength (R^2) and magnitude (slope) of the relationship between mean daily CPUE and reconstructed daily abundance differs when the outlier sites are, and are not, included in the daily CPUE estimate.
- The natural-log transform ($\log_e$) was applied to the dependent and independent variables in most analyses because observations of abundance are log-normally distributed.

Key findings:

- In Area 12, two sites (Cracroft Point and Sophia/Splash Island) tend to catch fewer fish (i.e., are biased low) and are more variable (i.e., have lower precision) than other sites (Figure 17), while in Area 13, one site (McMullen Point) tends to catch fewer fish than the other sites and another site (Chatham Point) tends to catch more fish than the other sites. Both sites in Area 13, along with Little Bear, have slightly more variable catches (i.e., have lower precision) than other sites (Figure 20). These sights are open water sets, as opposed to beach set, which may explain why catches are typically lower than at other test fishing set locations.
- In Area 12, the mean daily CPUE is consistently biased low when either Cracroft or Sophia/Splash Island sites are included in the daily estimate of CPUE (Figure 18). But because of the limited number of samples at these locations across the years, the exclusion of these two sites from estimates of daily CPUE does not result in an improved relationship between daily CPUE and abundance (Figure 19).
- In Area 13, the mean daily CPUE is consistently biased when McMullen Point (biased low) and Chatham Point (biased high) are included in the estimate of CPUE, respectively (Figure 21).
- The exclusion of catch from McMullen Point before estimating daily CPUE does not result in an improved relationship between daily CPUE and abundance (Figure 22).
- The exclusion of catch from Chatham Point before estimating daily CPUE results in a slightly weaker relationship between daily CPUE and abundance in a few years (Figure 23).

Implications on refinements to test fishery program:

- Catch from three test fishing set locations in Areas 12 (Sophia/Splash Island and Cracroft Point) and 13 (McMullen Point) appear to not be indicative of the overall abundance of fish migrating through the strait at any given point in time. These locations consistently catch fewer fish than other locations and excluding them from the daily CPUE estimate would improve the quality of it. However, given the limited number of catch samples taken at these locations compared to the total number of samples, and due to the uncertainty in the corresponding catchability estimate to convert CPUE into daily abundance estimates the improvement in the daily CPUE estimates are insufficient to substantially improve resulting abundance estimates.
- These locations are unique among the commonly used locations because they are on the opposite side of the strait in each Area (Figure 24 and Figure 25). They are also all open water sets, in contrast to the remaining locations which are beach sets. While these locations tend to catch fewer fish, they help inform the amount of sockeye migrating through the north (Cracroft Point and Sophia/Splash Island in Area 12; Figure 24) or west (McMullen Point in Area 13; Figure 25) side of the strait.

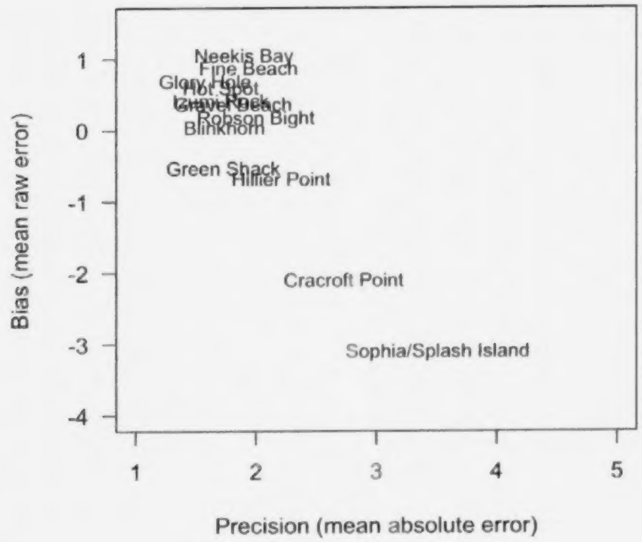

Figure 17: Bias (mean raw error) and precision (mean absolute error) of sockeye catch from test fishing sites in Area 12. Note that error is on the loge scale and only those sites that are regularly part of the assessment (i.e., greater than 100 observations) are plotted.

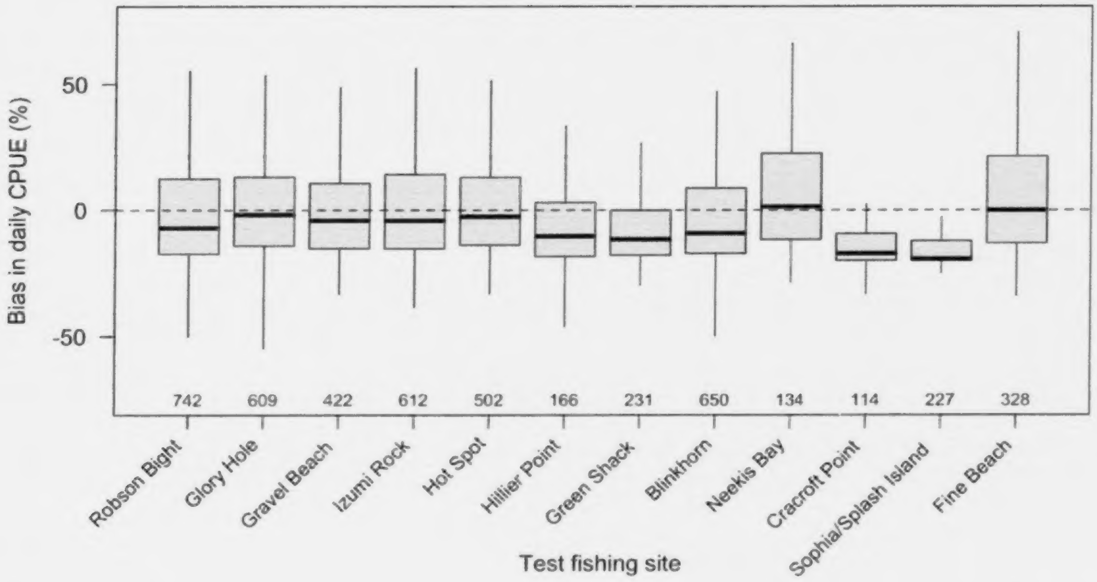

Figure 18: Percent difference in mean daily CPUE when individual test fishing sites in Area 12 are, and are not, included in the estimate. A negative bias, for example, means the mean daily CPUE is lower when the site is included in the estimate. The numbers above each site name indicate the number of assessment sets for each site between 1998-2016.

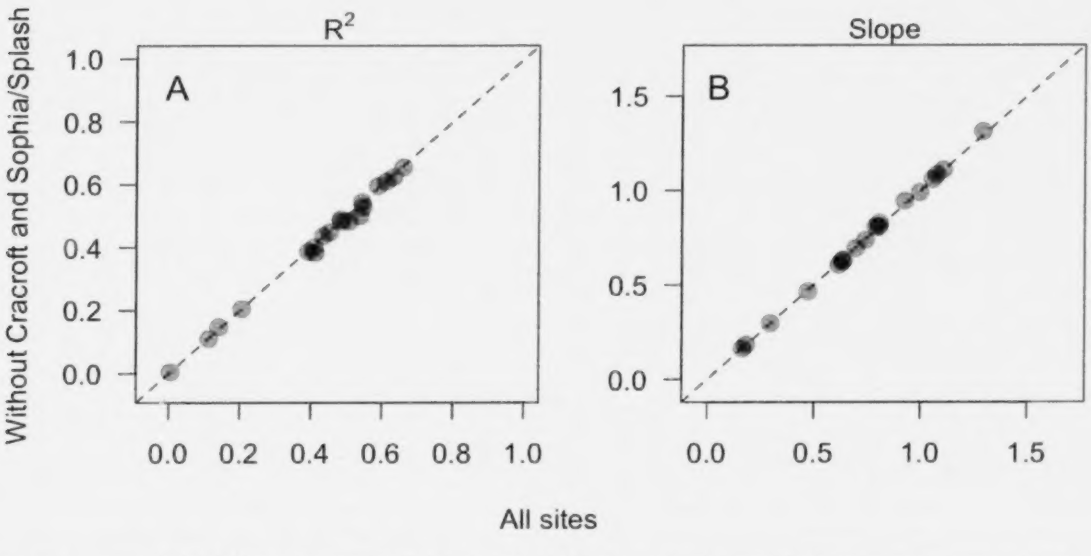

Figure 19: Strength (A; R2) and magnitude (B; slope) of the annual relationship between reconstructed daily Summer-run abundance and mean daily Area 12 CPUE with and without the Cracroft Point and Sophia/Splash Island test fishery sites included in the daily CPUE estimate.

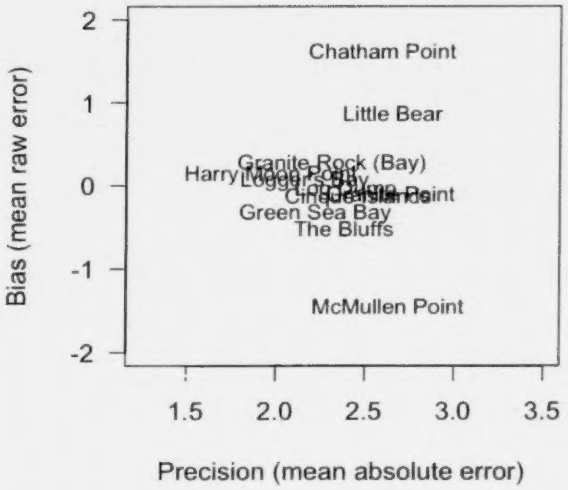

Figure 20: Bias (mean raw error) and precisions (mean absolute error) of CPUE from test fishing sites in Area 13. Note that error is on the loge scale and only those sites that are regularly part of the assessment (i.e., greater than 100 observations) are plotted.

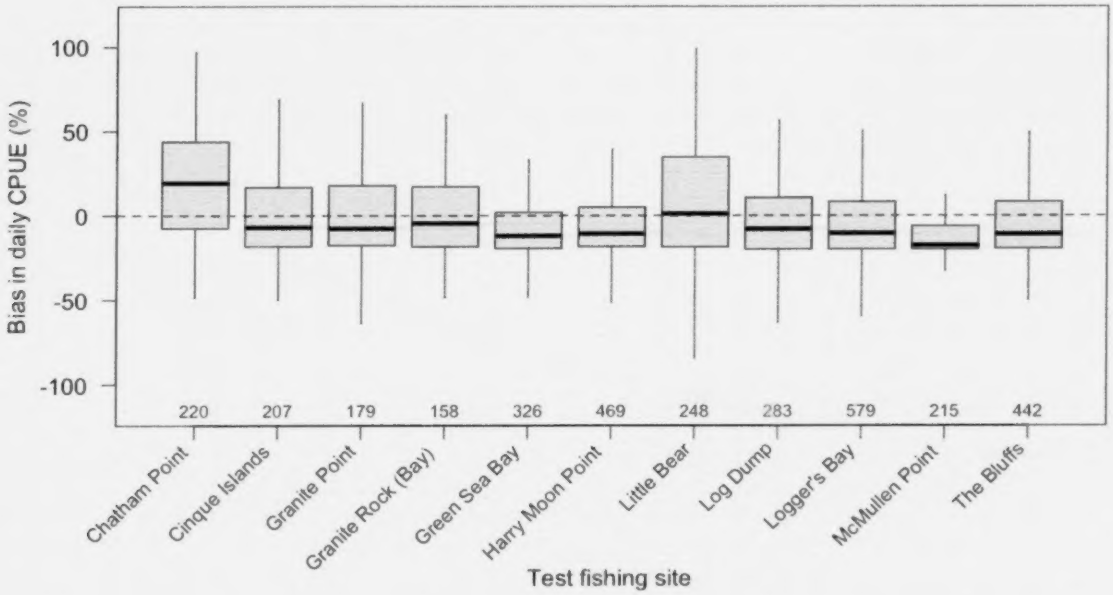

Figure 21: Percent difference in mean daily CPUE between when individual test fishing sites in Area 13 are, and are not, included in the estimate. A negative bias, for example, means the mean daily CPUE is lower when the site is included in the estimate. The numbers above each site name indicate the number of assessment sets for each site between 1998-2016.

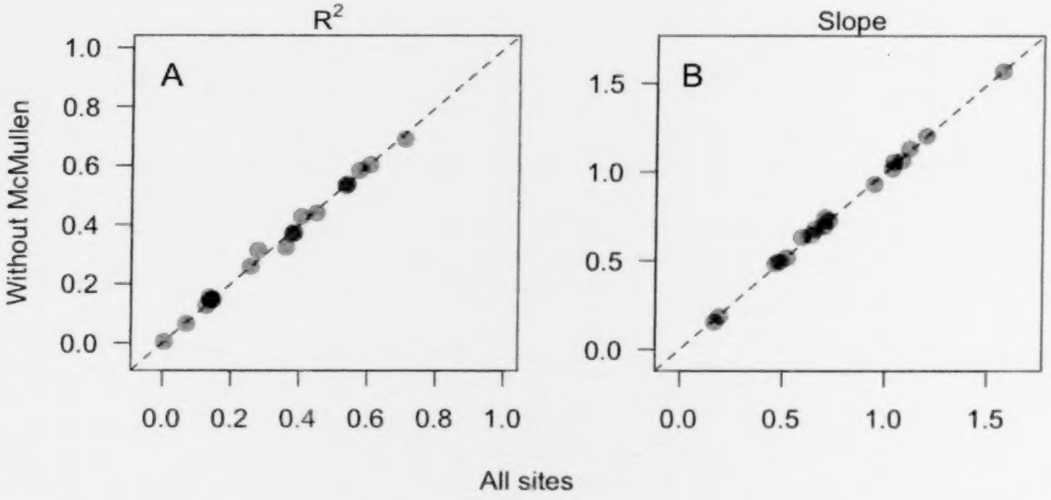

Figure 22: Strength (A; R2) and magnitude (B; slope) of the relationship between reconstructed daily Summer-run abundance and mean daily Area 13 CPUE with and without the McMullen Point test fishery sites included in the daily CPUE estimate.

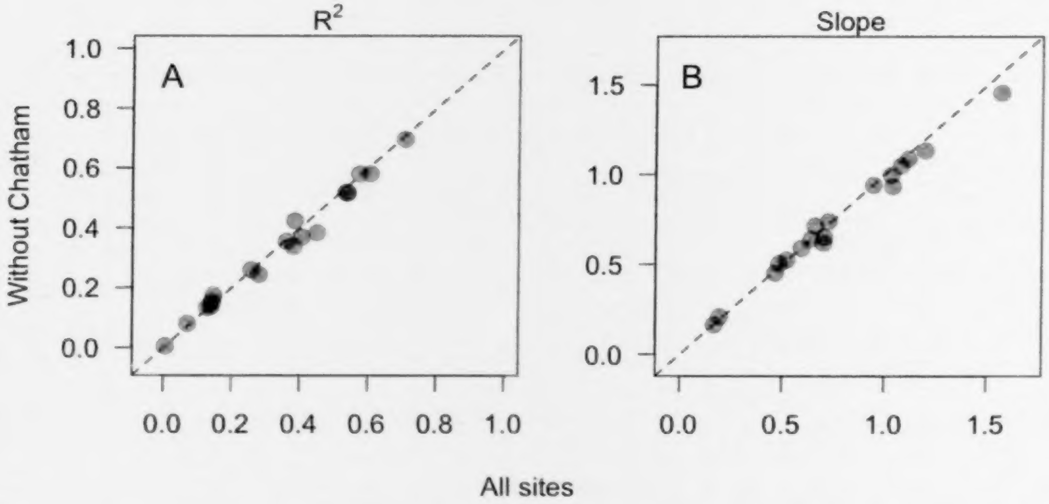

Figure 23: Strength (A; R2) and magnitude (B; slope) of the relationship between reconstructed daily Summer-run abundance and mean daily Area 13 CPUE with and without the Chatham Point and Little Bear test fishery sites included in the daily CPUE estimate.

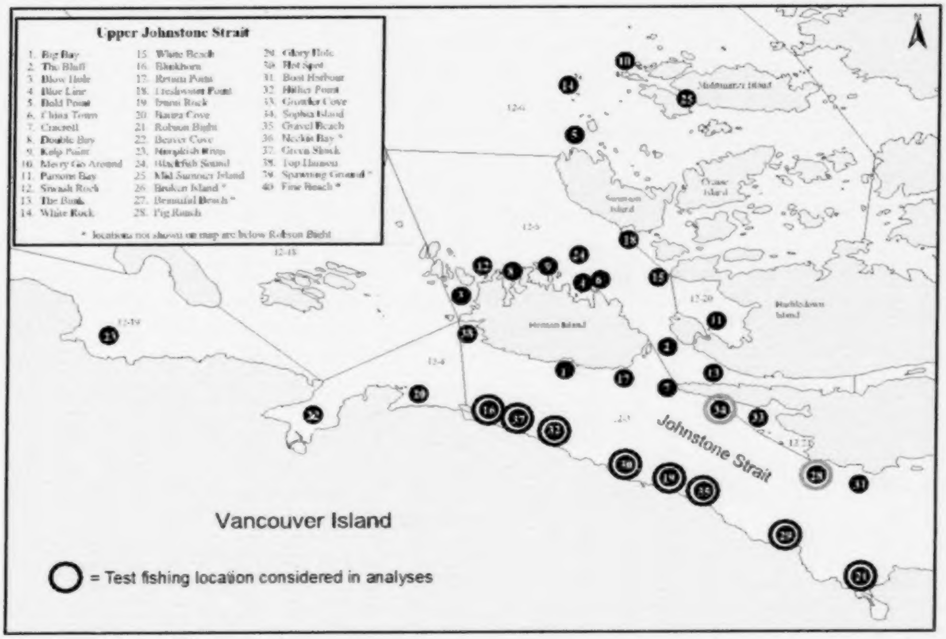
Upper Johnstone Strait
1. Big Bay
2. The Bluff
3. Blow Hole
4. Blue Line
5. Bold Point
6. China Town
7. Cracroft
8. Double Bay
9. Kelp Point
10. Merry Go Around
11. Parsons Bay
12. Swanah Rock
13. The Bank
14. White Rock
15. White Beach
16. Blinkhorn
17. Return Point
18. Freshwater Point
19. Izumi Rock
20. Bauza Cove
21. Robson Bight
22. Beaver Cove
23. Nimpkish River
24. Blackfish Sound
25. Mid Sumner Island
26. Broken Island *
27. Beautiful Beach *
28. Pig Ranch
29. Glory Hole
30. Hot Spot
31. Boat Harbour
32. Hillier Point
33. Growler Cove
34. Sophia Island
35. Gravel Beach
36. Necker Bay *
37. Green Shack
38. Top Hanson
39. Spawning Ground *
40. Fine Beach *
* locations not shown on map are below Robson Bight
Midsummer Island
Swanson Island
Crease Island
Hanson Island
Harbledown Island
Johnstone Strait
Vancouver Island
○ = Test fishing location considered in analyses

Figure 24: Location of Area 12 test fishery set locations considered in our analyses (circles) with outlier locations identified in red. Map courtesy DFO.

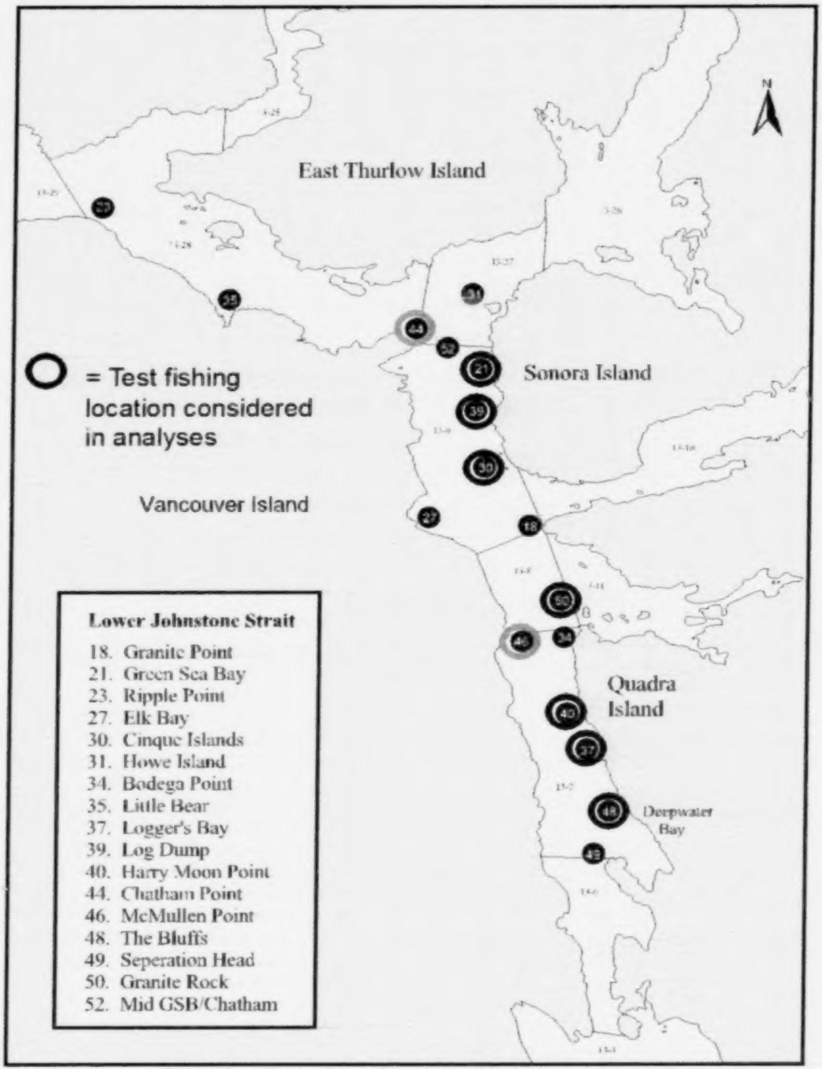
East Thurlow Island
Sonora Island
○ = Test fishing location considered in analyses
Vancouver Island
Quadra Island
Deepwater Bay
N
Lower Johnstone Strait
18. Granite Point
21. Green Sea Bay
23. Ripple Point
27. Elk Bay
30. Cinque Islands
31. Howe Island
34. Bodega Point
35. Little Bear
37. Logger's Bay
39. Log Dump
40. Harry Moon Point
44. Chatham Point
46. McMullen Point
48. The Bluffs
49. Seperation Head
50. Granite Rock
52. Mid GSB/Chatham
23
35
31
44
52
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Figure 25: Location of Area 13 test fishery set locations considered in our analyses (circles) with outlier locations identified in red. Map courtesy DFO.

Can catch information from commercial ITQ purse seine fisheries improve in-season estimates of Fraser sockeye run size? (Activity #6B)

Problem context:

It has been suggested that commercial catch data could be used as an additional source of in-season information to inform Fraser sockeye run size estimates. In 2015, in response to this suggestion, the Fraser Panel funded an exploration of the use of catch information from the "Individual Transferable Quota" (ITQ) purse seine fishery in Areas 12 and 13 to inform Fraser sockeye run size (Cave 2017).

Two key findings from Cave (2017) were:

- Full logbook ITQ CPUE is correlated with reconstructed Fraser sockeye abundances and these relationships are stronger than the relationships between purse seine test fisheries CPUE and reconstructed abundance; and
- In Area 13 catchability estimates from the ITQ fishery are similar to those for the test fishery, but in Area 12 the ITQ fishery tends to have lower catchability than the test fishery.

The analyses described here build upon those described in Cave (2017) and seek to answer the following specific questions:

- How representative is ITQ CPUE[21] of Area 12 and 13 CPUE?
- Is ITQ CPUE a better predictor of Area 12 and 13 daily abundances than test fishery CPUE?

Methods:

Data:

- Average[22] CPUE in the ITQ fishery in Area 12-3 and Lower and Upper Area 13 in 2010 and 2014[23].
- Reconstructed Summer-run abundance in Area 12-3 and Lower and Upper Area 13 in 2010 and 2014.

Analyses:

- Related ITQ CPUE to Area 12 and 13 CPUE to quantify the relationship between ITQ and test fishery CPUE, and evaluated possible differences in catchability between the fisheries.
- Used the ratio of ITQ to test fishery CPUE to generate a test fishery equivalent CPUE from the ITQ data. These ITQ based CPUE estimates where then used to derive an in-season prediction of reconstructed daily abundance and compared to post-season reconstructed daily abundance in the same area.
- Quantified precision (mean percent raw error, MPE) and bias (mean absolute percent error, MAPE) of ITQ and test fishery derived daily abundance estimates when compared against post-season reconstructed abundance estimates.
- The natural-log transform ($\log_e$) was applied to the dependent and independent variables in most analyses because observations of abundance are lognormally distributed.

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[21] CPUE is defined as catch per purse seine set throughout this memo.

[22] Average CPUE was calculated as the average of the catch per set across the boats for each day, which gives equal weight to each vessel

[23] From complete logbooks submitted at the end of the season by vessel masters (Cave 2017).

Key findings:

Area 12 results:

- The estimated catchability in the ITQ fishery is lower than at the current Area 12 purse seine test fishery locations, resulting in lower CPUE (i.e., ~60% of Area 12 test fishery CPUE) (Figure 26).
- Using ITQ CPUE data to quantitatively predict abundances generates similar in-season predictions to those obtained from Area 12 test fishery data in terms of bias and precision. However, in 2014 abundance estimates derived from the ITQ CPUE data less precise than those derived from test fishery data (Figure 27).

Area 13 results:

- The estimated catchability in the ITQ fishery is less than at the current lower Area 13 purse seine test fishery locations, resulting in lower CPUE (i.e., ~80% of Area 13 test fishery CPUE) (Figure 28). Using ITQ CPUE data from lower Area 13 to quantitatively predict abundances generates similar in-season predictions compared to lower Area 13 test fishery data (Figure 29).
- In contrast, the estimated catchability in the ITQ fishery is the same as the current upper Area 13 purse seine test fishery locations (Figure 30). But, using upper Area 13 ITQ data generates more biased and less precise in-season predictions than the upper Area 13 test fishery data (Figure 31).

Implications on refinements to test fishery program:

Because Area 12 and lower Area 13 ITQ catchability is lower than in the test fishery, their consideration as an additional source of information for in-season run size estimation would require a separate catchability estimate to be derived before ITQ data could be used to predict run size in-season (e.g., the Area 12 ITQ data could be converted into an Area 12 test fishery "equivalent" based on the ratio of ITQ to test fishery CPUE).

Once differences in catchability are accounted for, Area 12 and lower Area 13 ITQ CPUE appear to generate Summer-run sockeye abundance predictions that have a generally similar (or improved) magnitude of bias and precision as the existing test fisheries. As a result, ITQ data from these Areas warrant consideration as additional sources of information (in addition to test fishery CPUE) for in-season run-size estimation in years when ITQ fisheries occur.

While upper Area 13 ITQ catchability is similar to the Area 13 test fishery, Area 13 ITQ CPUE generates more biased and less precise predictions of Summer-run sockeye abundance than the test fishery. The magnitude of these differences in bias and precision should be taken into account when considering using upper Area 13 ITQ CPUE as an additional source of information (in addition to test fishery CPUE) for in-season run size estimation in years when ITQ fisheries occur.

Full logbook data from the ITQ fishery are not currently available real time in-season. For ITQ catch information to be useful in-season, these data would have to be reported electronically and made available by the end of each fishing day (Cave 2017).

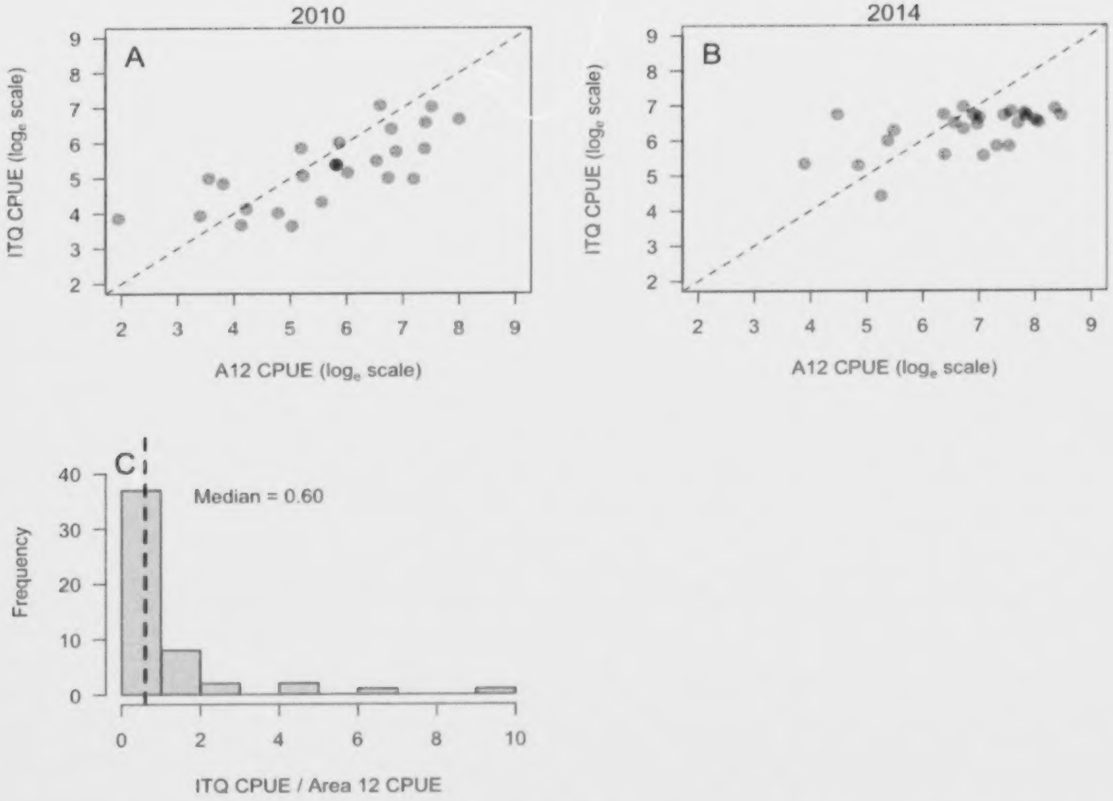

Figure 26: Relationship between ITQ and Area 12-3 CPUE in 2010 (A) and 2014 (B) as well as a histogram of the ratio of ITQ to Area 12-3 CPUE across both years (C).

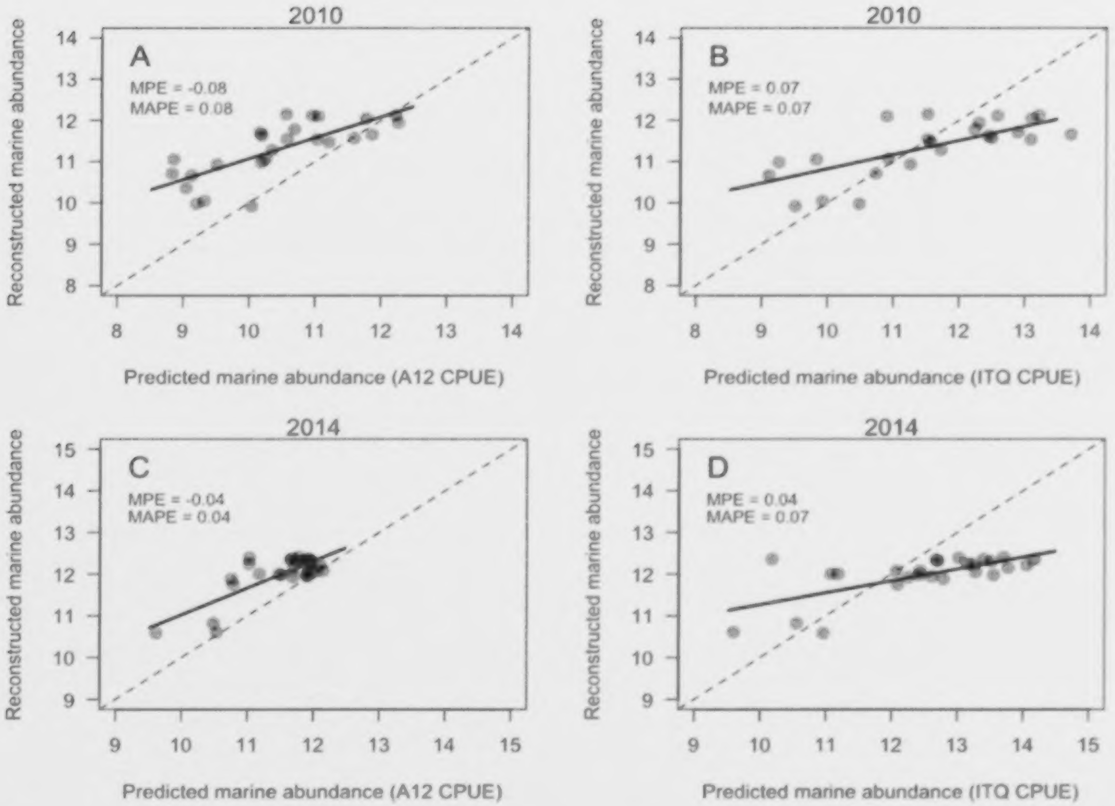

Figure 27: Relationship between predicted sockeye abundance (based on expanded CPUE) and true abundance in Area 12-3 based on Area 12-3 test fishery (A and C) or ITQ CPUE (B and D). Precision (mean percent raw error, MPE) and bias (mean absolute percent error, MAPE) are provided for each relationship. Note all data are on loge scale.

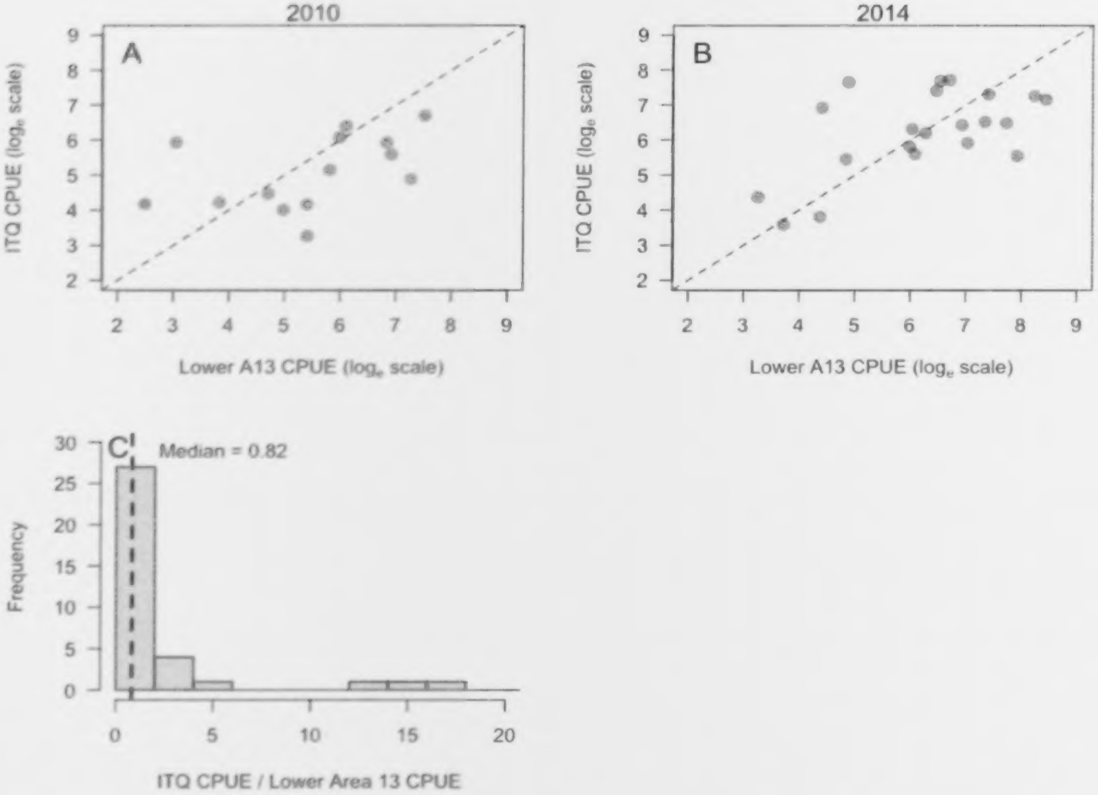

Figure 28: Relationship between ITQ and lower Area 13 CPUE in 2010 (A) and 2014 (B) as well as a histogram of the ratio of ITQ to lower Area 13 CPUE across both years (C).

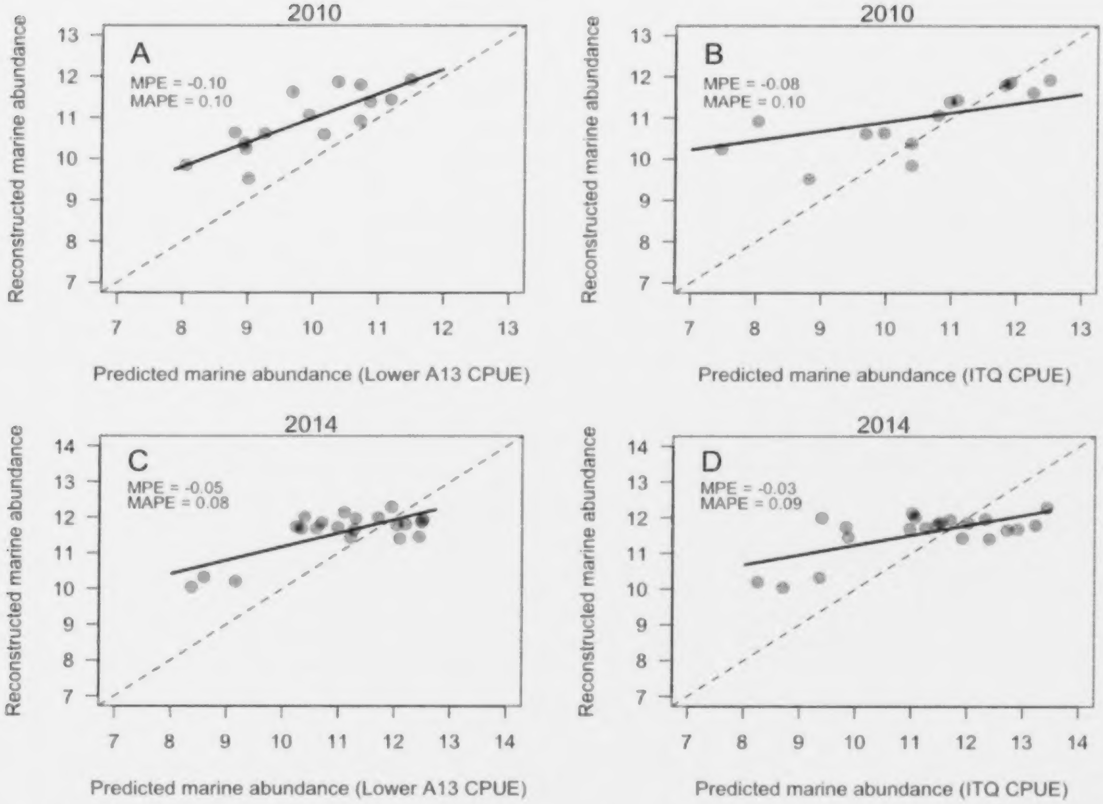

Figure 29: Relationship between predicted sockeye abundance (based on expanded CPUE) and reconstructed abundance in lower Area 13 based on Area 13 test fishery (A and C) or ITQ CPUE (B and D). Precision (mean percent raw error, MPE) and bias (mean absolute percent error, MAPE) are provided for each relationship. Note all data are on loge scale.

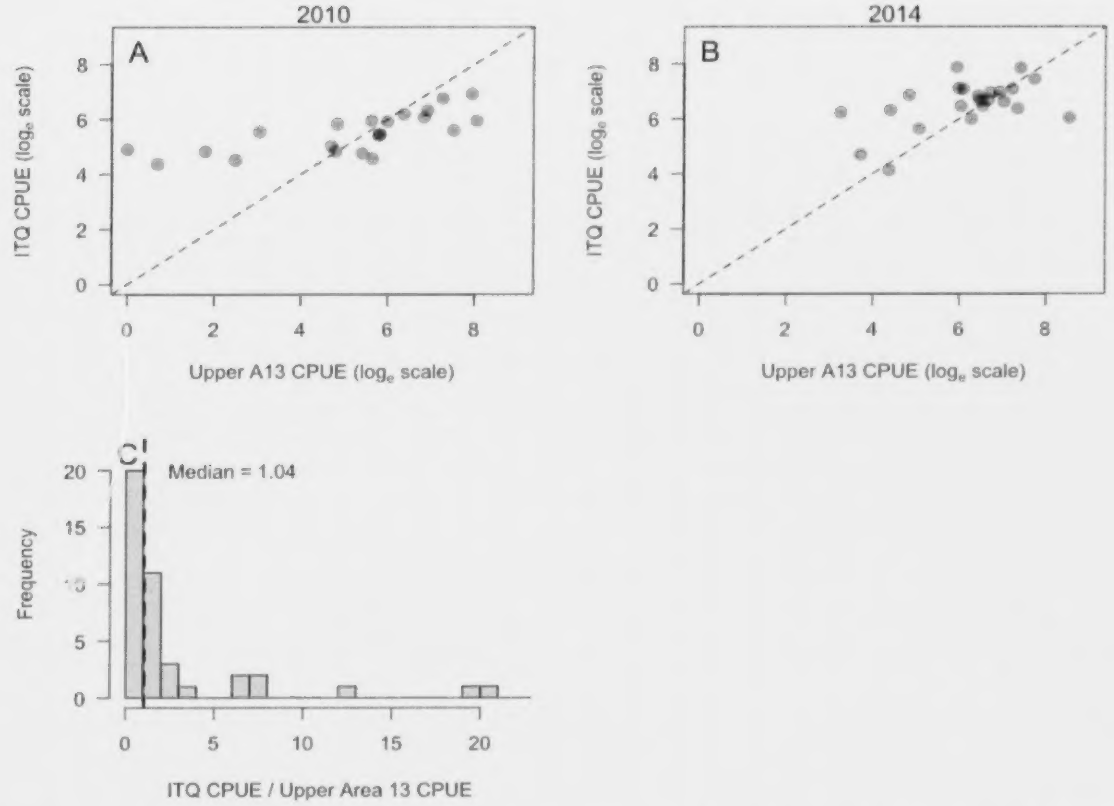

Figure 30: Relationship between ITQ and Area 13 upper CPUE in 2010 (A) and 2014 (B) as well as a histogram of the ratio of ITQ to upper Area 13 CPUE across both years (C).

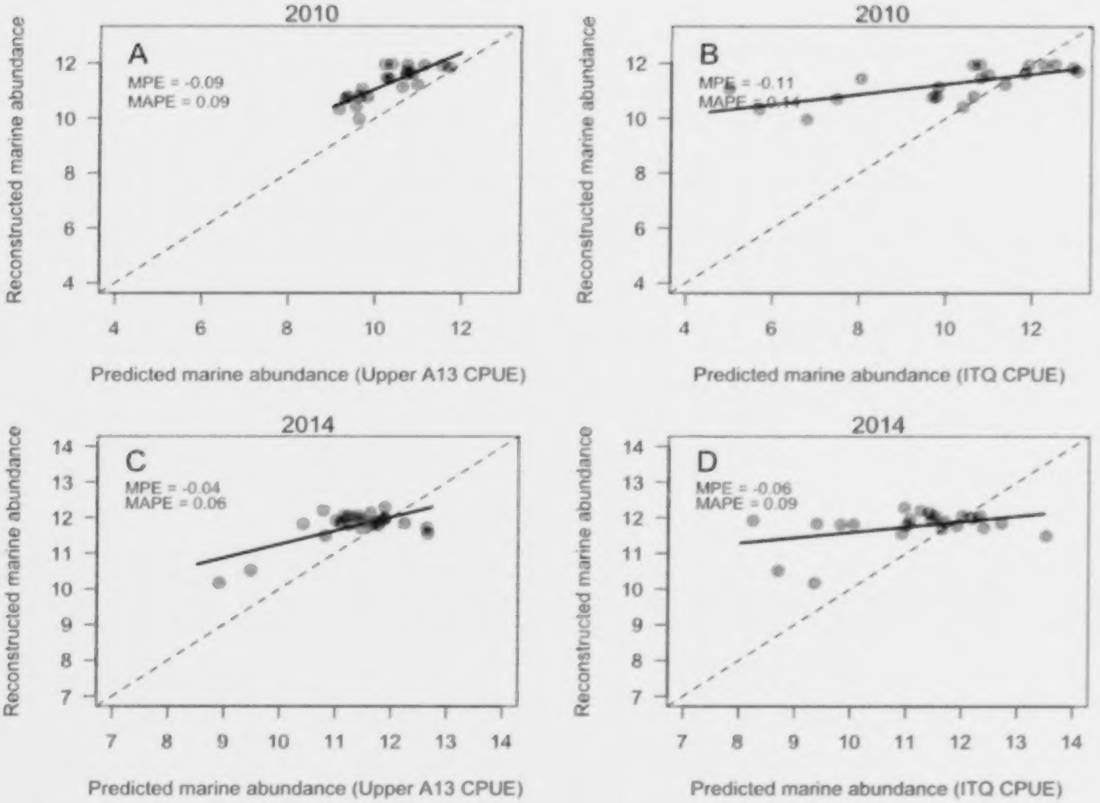

Figure 31: Relationship between predicted sockeye abundance (based on expanded CPUE) and reconstructed abundance in upper Area 13 based on Area 13 test fishery (A and C) or ITQ CPUE (B and D). Precision (mean percent raw error, MPE) and bias (mean absolute percent error, MAPE) are provided for each relationship. Note all data are on loge scale.

What is the impact of using one versus two boats in the Area 20 gillnet test fishery? (Activity #6C)

Problem context:

Traditionally, three different boats participated in the Area 20 gillnet test fishery. The Area 20 test fishery operated continuously throughout the season by having two boats fish simultaneously with each boat fishing for 8 days followed by a 4 day break. It has been suggested that the test fishery reduce fishing effort to a single boat per day, however, the consequences of this for estimates of CPUE and resulting abundance predictions are unknown.

The analyses described here seek to answer the following specific questions:

- To what extent is CPUE correlated among individual test fishing boats in Area 20?
- Do some fishermen consistently catch more or less fish than others?
- What is the magnitude of the change in bias and precision in daily CPUE estimates when the number of test fishing boats operating each day is reduced from two to one?
- How does the error in the daily CPUE estimate when using data from one boat instead of two compare to the error in the assumed catchability when deriving daily abundance estimates?

Methods:

Data:

- Daily gillnet CPUE estimates for Fraser sockeye excluding Late-run stocks and Harrison in Areas 20 and 12 from 1998 to 2014.
- Daily CPUE of individual gillnet boats in Area 20 from 1998 to 2014.
- Daily CPUE data for individual fishermen in Area 20 from 2011 to 2015.
- Reconstructed daily marine abundance estimates from 1998 to 2016 for Fraser River sockeye salmon excluding Late-run stocks and Harrison.

Analyses:

- Compared the CPUE of the two gillnet boats, and of individual gillnet fishermen, test fishing on the same day.
- Quantified the bias and precision error in CPUE introduced by using one boat instead of the average of 2 boats.
- Conducted a retrospective analysis to predict daily abundance estimates using CPUE of individual boats versus the average of two boats in combination with in-season catchability estimates.

Key findings:

- Even though CPUE differs between two boats fishing on the same day, CPUE estimates are strongly correlated (R^2=0.69) (Figure 32A).
- There is no directional bias in CPUE obtained from one boat versus two, but the estimates are not as precise (Figure 32B). Overall, the mean absolute percent error (MAPE) in the daily CPUE data is 21%, meaning that the CPUE obtained by one boat will on average differ by 21% from the average CPUE of 2 boats. When evaluating CPUE data over 6 days, the mean absolute percent error decreases to 10%.

- When daily abundance estimates are low (as well as corresponding CPUE estimates), there does not seem to be directional differences between the CPUE of individual fishermen (Figure 33A). When daily abundances are high, there may be a directional bias in the CPUE of individual fishermen (Figure 33B).
- Very similar daily and total abundance estimates are generated by the CPUE data obtained from individual boats and from both boats combined, however, these abundance estimates may differ substantially from the reconstructed daily abundance based on Mission and seaward catch. For example, Figure 34 illustrates this graphically for the years 2008 and 2012, two years when diversion rates where very low.
- Inter- and intra-annual variability in catchability has a much bigger impact on the precision of daily abundance estimates than the number of boats used to calculate the average CPUE. The retrospective analysis indicated that while the absolute mean run size error is about 23%, only 4% can be attributed to using 1 versus 2 boats to collect CPUE data.
- The impact of using data from only one boat instead of two decreases as data are pooled over multiple days and the methods used to estimate run-size are designed to be robust to daily CPUE variation by relying on multiple days of data.

Implications on refinements to test fishery program:

Reducing the number of test fishing boats operating each day in Area 20 from two to one results in less precise (and at high abundance biased) estimates of CPUE. This leads to a modest (~4%) increase in in-season run size error. The following points should be also considered when contemplating a reduction in the number of test fishing boats in Area 12:

- Current data used for the analyses is impacted by the interaction between the two boats, as the two boats may assist each other when searching for salmon, covering a wider area of migration.
- If the test fishery schedule was reduced to one boat per night, consideration would have to be given to potential fisherman effect and the spatial pattern of fishing effort.
- Potential safety benefits of having two boats participating to the test fishery at the same time was not evaluated and requires further consideration.
- Having only one vessel may result in days without data or sample sizes that are too low for stock identification, requiring days of data to be pooled.
- Reducing the number of test fishing boats and the number of boat days does not result in a proportional reduction in test fishing costs as the daily charter rate increases with reduced test fishing days.

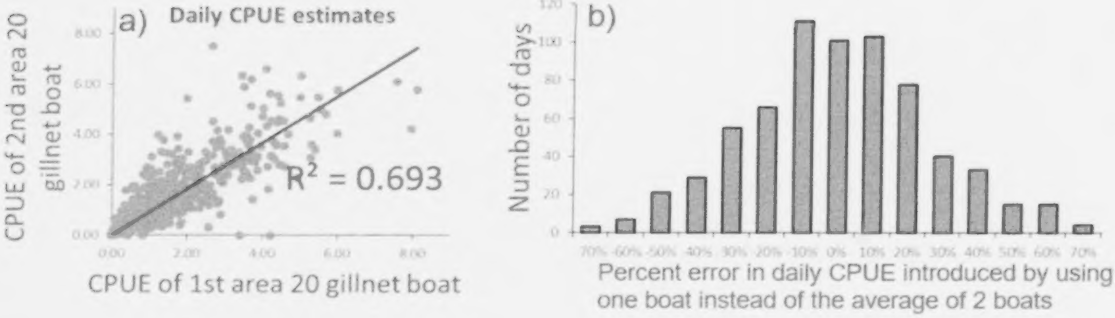

Figure 32: (A) Correlation between the CPUE of gillnet vessels fishing on the same day in Area 20, and (B) percent error in daily CPUE estimates introduced by using CPUE from only one boat instead of the average of two boats.

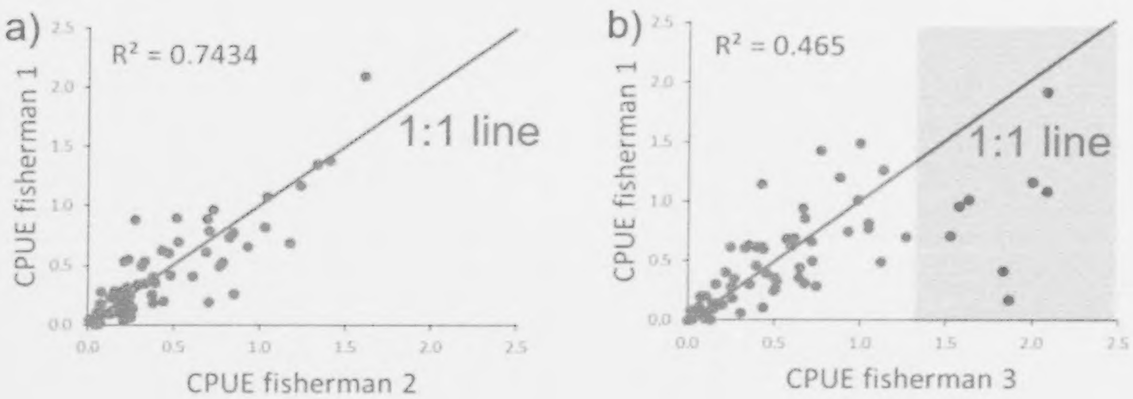

Figure 33: (A) Correlation between the CPUE of a) fisherman 1 and fisherman 2, and (B) fisherman 1 and 3 when fishing on the same day. As abundance increase, the CPUE of fisherman 3 becomes larger than the corresponding CPUE of the first fisherman (area shaded in red).

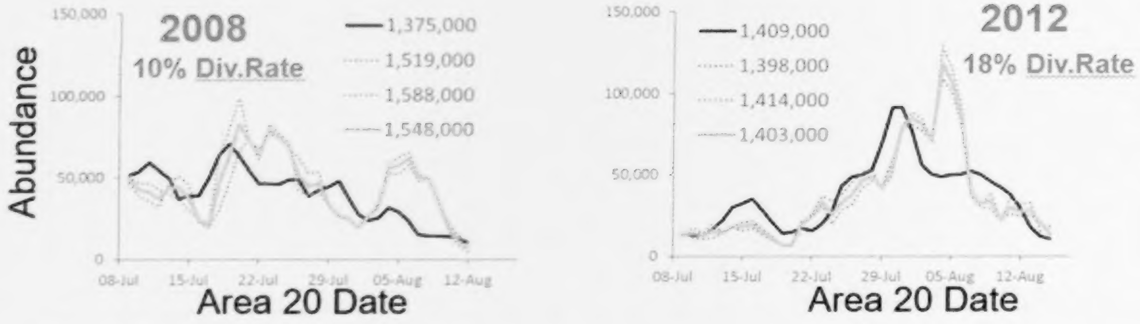

Figure 34: Three day moving average of the daily reconstructed abundance of Fraser sockeye excluding Late-run and Harrison (black line), as well as the 3 day moving average of abundance predictions based on CPUE of two boats (orange line) or individual boats (broken blue and pink lines) for two example years with low diversion rates.

What are the advantages and disadvantages of different configurations of the Fraser River gillnet test fisheries? (Activity #7)

Problem context:

It has been suggested that some of the river test fisheries may be removed from the current suite of Fraser River gillnet test fisheries. The pros and cons of dropping and /or reducing one of the current river gillnet test fisheries have been evaluated in this section.

Methods:

This evaluation summarized several prior analyses and Fraser River Panel presentations on gillnet test fisheries in the Fraser River. The latest presentation was made to the Fraser River Panel in January 2017. Tables presented to the Panel in January 2017 summarize the implications of reducing and / or consolidating in-river test fisheries (see Table 7 through Table 10).

Key findings:

Each Fraser gillnet test fishery is an integral part of a program and as such is designed with very specific and different objectives in mind. The different programs and test fishery designs have led to differences in the gear used as well as differences in the periods during which the test fisheries are operational. Over the years, a substantial amount of historical data has been accumulated based on a consistent test fishing method that is essential to most programs fulfilling their main objectives. Though potential savings in terms of program costs and fish mortality could be made by eliminating or substantially reducing one or more of the test fisheries, these savings would be offset by mitigative measures required to ensure that the program objectives are maintained (i.e. decreases in one program would require increases in the remaining programs).

Implications on refinements to test fishery program:

The value of information obtained from these test fisheries relates to their required purposes which differs among the different test fisheries.

The Cottonwood test fishery uses a variable mesh gillnet (i.e., 4 equal length panels, with each panel utilizing a different mesh-size. The mesh-sizes range from 4¼" to 5¾"). This gillnet was designed to optimize sampling of adult sockeye across their size ranges (i.e. designed to provide a random sample of sockeye salmon). It was designed to accomplish three main goals:

4. Provide an index of abundance and estimate of stock composition in the lower Fraser in advance of future larger scale fisheries (historically commercial, Area E).
5. Provide a sample for estimating stock composition which would include Pitt River sockeye (which are not captured in other current in-river test fisheries).
6. Provide samples for estimating stock composition for all sockeye stocks expected to migrate upstream in the Fraser River.

The first goal is less critical due to the reduced frequency of larger scale lower river fisheries, however goals 2 and 3 remain critical. Though estimation of Pitt River stock proportions is possible using data from marine gillnet test fisheries (after applying a migration rate assumption), the recent reduction in the Area 20 gillnet test fishery from two boats to one, means that marine samples sizes are reduced and may not be sufficient with the absence of the Cottonwood test fishery. Making additional sets in the other in-river upstream test fisheries to increase the sample size would likely result in minimal cost savings when eliminating or reducing the Cottonwood test fishery and would not provide a sample that includes stocks such as Pitt.

The Whonnock test fishery uses a variable mesh gillnet (i.e., 7 equal length panels, with each panel utilizing a different mesh-size. The mesh-sizes range from 4" to 8½"). It was designed to accomplish three main goals:

4. Provide an estimate of species proportions that are applied to the Mission acoustics estimates of total salmon to estimate the sockeye migration abundance.
5. Provide samples for stock composition and augment samples from the Cottonwood test fishery. It may be relied upon to estimate upstream migration of Late-run sockeye (that may be caught in higher proportions at Cottonwood) and it was used to help estimate Pitt sockeye during the scale-based years by comparing Nadina/Gates/Pitt estimates at Cottonwood (which contained Pitt) to Whonnock (which contained Nadina/Gates only).
6. Provide an abundance estimate of sockeye migrating upstream during periods when pink salmon migration predominates in Fraser River (i.e. Whonnock test fishing sockeye CPUE multiplied by an expansion line is used to estimate sockeye abundance instead of the total salmon (from acoustics estimates) multiplied by the Whonnock derived species proportions.

All three goals remain valid today (though it is not needed to help with Pitt estimation now that stock identification is based on genetics).

The Albion test fishery uses three different gillnets:

4. A variable mesh gillnet consisting of 8 panels utilizing 4 different mesh-sizes that range from 6" to 9"). The net is fished every second day from April to September,

5. An 8" chinook gillnet is fished every alternate day from April to October 20
6. A 6¾ "chum gillnet is fished every second day from September 1 to October 20 followed by fishing every day until mid-late November.

CPUE and stock composition information collected during the Chinook period are used to inform Canadian domestic management decisions related to the Chinook chapter of the Pacific Salmon Treaty (PST). CPUE and stock composition information collected during the Chum migration period are used to inform decisions related to the Chum chapter of the PST.

The savings in terms of test fishery program costs and fish mortality (varies by species) associated with alternative combinations of in-river test fisheries is outlined below (see Table 7 through Table 10). However, additional costs associated with potential mitigative measures have not been estimated, but would offset potential savings when reducing or combining river test fisheries. In addition, additional calibration studies would need to be conducted prior to substituting test fisheries and a proper calibration would require sufficient years of data during which both the old and new test fishery configuration need to be run simultaneously.

The feasibility of implementing a refinement to the number of river test fisheries or their operational periods would also include logistical considerations (e.g., mesh sizes, program location and duration) and discussion of potential mitigation measures that would span multiple Chapters of the PST. There would be a need to engage groups beyond the Fraser Panel particularly with respect to the Albion and Qualark test fisheries.

Table 7: Summary of the implications of removing the Whonnock test fishery; consolidating the lower river test fisheries to include only the Cottonwood and Albion.

Implications of reduction or consolidation of River test fisheries

	Cottonwood & Albion
Estimated cost savings [1]	$103,000
Estimated reduced mortality [2]	1,000-3,500 sockeye, 1,000-5,000 pinks, 0-1,200 chum, < 100-1,500 Chinook, 0-500 coho
Impacts on data flow	1. Biased species composition to apply to the Mission hydroacoustics estimate. 2. Reduced representative sample sizes for sockeye stock ID. 3. Biased samples for stock ID from Albion. 4. Incomplete and/or biased of Early Stuart abundance prior to acoustics. 5. Imprecise and potentially biased estimates of Late-run (and Summer-run) abundance for estimating upstream migration after termination of acoustics.
Potential mitigating measures	1. Expand mesh sizes of variable mesh net at Albion to include smaller mesh sizes. 2. Do more sets at Cottonwood to increase sample sizes. 3. Only sample sockeye from Albion caught in new expanded gillnet (1 above). 4. Estimate Early Stuart abundance from CPUE at Albion with new net (1 above) prior to acoustics. 5. Project abundances after acoustics using Albion with added meshes.
Potenital costs of mitigation *(These would reduce cost savings shown in row 2)*	TBD, but would vary by option and include: 1. Charter costs for extending operational time frame and/or number of sets in remaining test fisheries. 2. Additional observers and/or time for bio-sampling using appropriate protocols. 3. Modifying nets to expand mesh sizes.

[1] Estimated 2017 full program cost

[2] Catch range 2013-2016

Table 8: Summary of the implications of removing the Cottonwood test fisheries; consolidating the lower river test fisheries to include only Whonnock and Albion.

Implications of reduction or consolidation of River test fisheries

	Whonnock & Albion
Estimated cost savings [1]	$73,000
Estimated reduced mortality [2]	1,000-5,500 sockeye sockeye, 1,000 pink, 0-100 chum, < 200 chinook, 0-60 coho
Impacts on data flow	1. Reduced representative sample sizes for sockeye stock ID. 2. Biased samples for stock ID from Albion.3. No samples for stock composition downstream of the Pitt River confluence. 4. No indicator of late-run sockeye in the lower Fraser and/ or delaying sockeye in the lower River, or potential biased estimate if using Whonnock CPUE.
Potential mitigating measures	1. Do more sets at Whonnock to increase sample sizes. 2. Expand mesh sizes of variable mesh net at Albion to include smaller mesh sizes. 3. Use pre-season forecast for In-season management of Pitt (and Widgeon). 4. Ignore potential delay of Late-run in lower Fraser (would impact ability to predict stock ID catches in this area.
Potenital costs of mitigation *(These would reduce cost savings shown in row 2)*	TBD, but would vary by option and include: 1. Charter costs for extending operational time frame and/or number of sets in remaining test fisheries. 2. Additional observers and/or time for bio-sampling using appropriate protocols. 3. Modifying nets to expand mesh sizes.

[1] Estimated 2017 full program cost

[2] Catch range 2013-2016

Table 9: Summary of the implications of removing the Albion test fishery; consolidating the lower river test fisheries to include only the Cottonwood and Whonnock.

Implications of reduction or consolidation of River test fisheries

	Cottonwood & Whonnock
Estimated cost savings [1]	$253,000
Estimated reduced mortality [2]	1,000-4,000 sockeye, 10,000-15,000 chum, 1,000-2,500 chinook, 100-1,000 coho
Impacts on data flow	1. No estimates of Chinook abundance early or Chum abundance late in the season. 2. No samples for Chinook Stock ID early in the season. 3. Reduced samples sizes and potentially biased samples of Chinook during period when Whonnock is operating.
Potential mitigating measures	1. Expand operational season at Whonnock to cover early and late periods and possibly alter net - more net length at optimal meshes for Chinook and Chum. 2. Do more sets at Whonnock to boost Chinook sample sizes. 3. Use pre-season forecasts for Chinook and Chum until such time as catchability of these species at Whonnock can be reliably estimated. 4. Continue Albion and extend period of Whonnock for a period of years to calibrate Chinook and Chum CPUEs across test fisheries.
Potenital costs of mitigation *(These would reduce cost savings shown in row 2)*	TBD, but would vary by option and include: 1. Charter costs for extending operational time frame and/or number of sets in remaining test fisheries. 2. Additional observers and/or time for biosampling using appropriate protocols. 3. Modifying nets to expand mesh sizes. 4. Operate all three test fisheries for a period of years to permit calibation of CPUE with remaining test fisheries.

[1] Estimated 2017 full program cost

[2] Catch range 2013-2016

Table 10: Summary of the implications of reducing or consolidating the Cottonwood and Whonnock test fisheries in combination with the Albion test fishery within the Fraser River.

Implications of reduction or consolidation of River test fisheries

	Cottonwood & Whonnock with Albion before and after
Estimated cost savings [1]	$80,500
Estimated reduced mortality [2]	~500-2,000 sockeye, ~500-2,000 chinook
Impacts on data flow	1. Potentially biased estimates of Chinook and Chum abundance based on Whonock (or Cottonwood) CPUE at end of Chinook migration and beginning of Chum migration. 2. Reduced samples sizes and potentially biased samples of Chinook during period when only Whonnock is operating.
Potential mitigating measures	1. Expand operational season at Albion to cover parts of late Chinook and Early Chum migration periods. 2. Use historical migration proportions to "tail out" later migration of Chinook and "tail in" earlier migration of Chum. 3. Alter net and or fishing pattern at Whonnock to provide better CPUE of Chinook and Chum and to increase sample sizes of Chinook for Stock ID when Albion is not operating.
Potenital costs of mitigation *(These would reduce cost savings shown in row 2)*	TBD, but would vary by option and include: 1. Charter costs for extending operational time frame and/or number of sets in remaining test fisheries. 2. Additional observers and/or time for bio-sampling using appropriate protocols. 3. Modifying nets to expand mesh sizes. 4. Operate all three test fisheries for a period of years to permit calibration of CPUE with remaining test fisheries.

[1] Estimated 2017 full program cost

[2] Catch range 2013-2016

Attachment F: Proceedings from Workshop #2

Improving Fraser River Test Fisheries and Run Size Estimates: Workshop #2 Proceedings

Prepared for: PSC Fraser River Panel
Prepared by: Marc Nelitz and Alex Hall, ESSA, Vancouver, BC

Summary of Major Outcomes

At the end of Day 2 of the workshop, each of the subgroups reported back to the plenary on the outcomes of their subgroup discussions (i.e., their highest priority refinements under each of the exercise scenarios). After hearing from each subgroup and recording their recommended refinements on flipcharts, there was a plenary discussion to identify common ideas that emerged from the subgroup exercises and recommendations on next steps going forward. The outcomes of these plenary discussions are reported in the following two sections.

Priority Refinements Common across Workshop Subgroups

Caveats and considerations

- The following items are not listed in any particular order. They are reported in the order they were raised, which does not imply prioritization.
- The following items represent the list of commonalities among subgroups as identified by workshop participants, but does not represent a more thorough review of the detailed worksheets from each subgroup to determine if other commonalities also exist.

"Untouchable" components

- A12 PS & GN, A20 PS & GN, and an in-river TF[24] are core components of the TF program
    - Removal of any of these components would be unacceptable to the group

Refinements in Common Across Sub-Groups

- Reduce Area 20 GN from 2 boats to 1 boat
- Improve data collection from ITQ fisheries for in-season use
- Improve data collection from FSC/C&S fisheries for in-season use
- Consolidate in-river TFs, perhaps to one if feasible and effective

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[24] It is critical to have at least one or two in-river TFs, though their specific configuration could potentially be different than their current design.

- Improve sampling design of Area 12/13 site locations (accounting for local environmental variables)
- Test use of marine sonar to assess late-run holding in the Gulf
- Improve pre-season planning and administration of TF schedule
- Remove TFs not used in run-size assessment OR require Parties to fund TFs that are only used for domestic purposes
- Reduce redundancies overall throughout TF program
- Explore potential for other seaward areas/fisheries to provide earlier information (e.g., Gordon Group, WCVI, Area 2W)
- Improve marketing and value of pay fish

Next Steps and Activities

Pre-amble

The activities proposed as potential next steps by the workshop participants in the final plenary discussion are summarized in the table below. Where relevant, further discussion on these items is provided below the table. For each row, the table indicates whether the proposed activity: (a) should be considered as a potential Southern Endowment Fund (SEF) project in the upcoming annual call for proposals, (b) would require actions to be implemented during the 2018 season, and/or (c) should be addressed after the 2018 season.

The 2018 season is particularly relevant because it is anticipated to be a dominant cycle year and some activities can only be implemented and tested in a high abundance year (e.g., using sonar on late run in the Gulf). If the 2018 season is missed, the next opportunity would be 2022.

The potential for activities in the 2018 season to be funded by the SEF would require Phase I proposals to be developed and submitted over the summer. If the Panel wishes to identify specific priorities for the call for proposals, those priorities need to be identified imminently.

The SEF is a potential mechanism for funding some of the proposed next steps; however, there are some important concerns that must be considered. Ultimately there are limited resources, both in terms of actual funds and people (esp. PSC staff) who can implement these activities. It was emphasized at the workshop that the PSC does not currently have the capacity to be the ones that lead, review, develop and work on the SEF proposals. Furthermore, the Panel must consider (promptly) whether the SEF call for proposals should be broad or focused with respect to potential projects in this area. If the call for proposals is general, then the Panel will have to wait to see what proposals come in and then evaluate (via the SEF committee) which are highest priorities – but the Panel may or may not get what it was most hoping for. It will likely be more productive for the Panel to be proactive in identifying specific work to be done (and prospective leads) so that the SEF call is focused on the highest priorities for work to be done during the 2018 season, but identifying specific priorities for the SEF call is extremely time sensitive.

Finally, not everything has to be SEF proposal, but regardless of how they are funded, the proposed activities need to be developed as specific projects with clearly defined objectives, deliverables and deadlines. If the structure of these activities is flexible and vague, then they may not be completed in a timely and beneficial manner.

Caveats and consideration

- The activities proposed below as next steps are not in order of priority
- The information below needs to be further supplemented / refined based on discussions amongst members of the Fraser River Panel

Summary table of next steps

Activity	SEF proposal (this year)	Implement actions in 2018	Post-2018	Potential entities involved	Additional comments and discussion
Test use of marine sonar to assess late-run holding in Gulf	Yes	Yes		PSC	
Improve ITQ data collection and reporting		Yes		Rob Morley, commercial sector, DFO, PSC	Need to work with commercial sector to specify exactly what will be collected and how it will reported. Recent work has been done so some tools already exist. Collect data in 2018 and use it to inform better program for 2022.
Improve FSC data collection and reporting		?	Yes	PSC, DFO, First Nations	*See additional discussion below table*
Include environmental information in Area 12/13 site analysis	Yes			PSC, DFO, ESSA, others	
Reduce Area 20 gillnet TF to 1 boat		Yes	Yes	PSC	Run as an experiment. Does this need to be in high abundance year?
Change configuration of in-river TFs	Yes	?	Yes	PSC, DFO, others	*See additional discussion below table*
Improve pre-season planning and administration of TF schedule		Yes	Yes	PSC, others	*See additional discussion below table*
Improve marketing and value of pay fish			Yes		Long-term initiative.

Additional discussion on particular activities

Improve FSC data collection and reporting

- Need to target specific questions and objectives and uses. Where? For what purpose? What types of analyses?
- This will requires additional design work. Maybe SEF-funded work.
- Timing uncertain – Is there a need to link to 2018?
    - Benefit in doing some comparisons in 2018 when abundances is high and therefore larger sample sizes; but not useful comparison in later season when stock composition is dominated by Late Shuswap and there isn't enough variation to make appropriate comparison.
- May be a link to optimize bio-sampling design. Stock composition and stock ID. Less variation in 2018.

Change configuration of in-river TFs

- Requires further analyses of impacts – any changes most likely implemented post-2018
- Also need to thoroughly consider impacts of changes in in-river TFs on other species management – e.g. Chinook, Chum
- Cottonwood may be affected by bridge construction (i.e., Massey Tunnel replacement project), which may be an additional reason for considering relocation or modification
- There are important differences between how marine and in-river FSC fisheries are implemented
    - in-river FSC fisheries are communal (many fishers) and therefore only open for very short windows (e.g., 48 hours), therefore only get data from one point in the season, rather than ongoing data collection over longer portion of the season

Improve pre-season planning and administration of TF schedule

- Desired goal – a template for the proposed TF schedule in a particular type of year
- Current situation – there are many iterations of analyses, costing, tradeoffs, etc., which are very time consuming for the PSC. The development and analyses of TF options takes months of secretariat time and it should only take weeks or days of time. Part of issue relates to the transition from more comprehensive programs in the past to reduced programs today.
- Significant time could be saved if instead of the PSC offering different menus of TF options, it could just definitively specify the program that will be implemented given pre-season information
- Generally starting TFs at the same time, but ending is uncertain (if pinks or lates are abundant, then run TFs longer). Can also use cheaper TFs to determine when to start more expensive TFs.
- This may not require extensive effort as much of the work may already be done – i.e., it arises out of discussions over the TF program for 2016, 2017 and 2018. Use these years as starting points then formalize them as templates to apply to similar types of years in the future.

- Have multiple years of experience, but the last two have been different because we've had more substantial conservation (and financial) issues – demands sharper lens re: conservation and cost.
- Who is responsible for developing this further? TBD - the Panel needs to have further conversation about this subject

Other

- If there is a desire for additional sampling / DNA from other seaward sources – this will require addition funds (from SEF or elsewhere)

Workshop Notes

These notes are the "stream-of-record" notes taken during the workshop. They have not been further consolidated for conciseness or reviewed by participants for accuracy.

Opening Remarks

Jennifer Nener

- Welcome, thank you
- Appreciate making time during busy time of year
- Tremendous amount of work since first workshop (especially since Feb)
  - Acknowledge large amount of work and analysis
- Well-positioned for discussions over next 2 days

Overview of agenda

Marc Nelitz

- Believe in collective wisdom of the group to make good decisions
- Today group will be receiving a lot of information – apologies for material distributed late last week – but the information is valuable, and we needed the time for the team to complete their analyses
- "Begin with the end in mind" – Stephen Covey
  - Trying to identify priority refinements to the TF program
  - Outcomes of this workshop will be taken by Panel and Commissioners to make decision
- Everyone should ask questions to boil down complexities to the issues that really matter to you
- Overview of objectives
  - Review of work and analyses done
  - Identify priority refinements
  - Identify other work that would be necessary/helpful
- Walk through agenda
- Review meeting norms

Context and scope of this review

Jennifer Nener

- Why are we here, where we began, what are next steps
- Test fisheries – each have different purposes, but contribute to overall assessment processes
- Drivers for review
    - Financial constraints
    - Need to have best assessment within budgets
    - Suggestions for alternate approaches/opportunities
    - Current review of hydro-acoustics
- Purpose & scope – see slides
- Status & next steps
    - Workshop 1 outcomes
    - Today's workshop
    - Next – Panel to consider findings and make recommendations, outcomes of TF & Hydroacoustics reviews to be considered by Commission
        - Consider these in parallel – they are the two core components of the assessment program
    - Then direction will be given moving forward

Overview of workshop #1

Alex Hall

- see slides
- Recap of workshop 1 – objectives, content
- Key components
    - Performance criteria
    - Portfolios

Mike Lapointe

- see slides
- Goal – explain how we arose at the list of activities to work on – didn't come out of thin air!
- Strengths and limitations – from pre-workshop survey, from workshop deliberations, from workshop reflections
- List of gaps/limitations – compressed from longer list (grouped similar themes)
    - See slides
- Suggestions/considerations from portfolio exercises
    - High/med abundance – some general, some TF-specific
    - Low abundance
- Workshop reflections – see slides
    - Balance is a key – how much cost/mortality is acceptable, don't know what the target is, which makes developing a program difficult
- Table 1 from report – summary of priority areas

  - Each covered in more detail in presentations and handouts
  - Activity 8 (marine sonar) is covered under umbrella of Activity 4 (doesn't have a stand-alone presentation and/or handout

Perspectives of participants about this review

Roundtable on: (A) hopes/concerns on process, and/or (B) reflections on workshop #1

- re: Mike's slide on limitations, "variability in catchability" and "tides and water" – these should be integrated – catchability variability is driven by such environmental conditions
- good summary of workshop; good discussion on lots of those points – lots of science work since then. Look forwad to discussion, and hope to come up with some "gems" going forward.
- presentation brought coherence to discussions that came up in November. Re: what is our target, and how to we balance conservation/cost/mortality – our target is to provide information necessary to manage fisheries management decisions. Looking forward to drilling down.
- workshop #1 concluded that there is no silver bullet. Left with concern about "what are we going to get out of this process?" Answer = new analyses of old data, application of good science to the issues at hand. Good outcome. Also, looking forward to drilling down.
- good summary. Started review based on cost limitation, so need to keep that in mind. Seaward data is very important to US.
- previously worked for ADFG – Fraser Sockeye is one of the most data-rich systems that there is, perhaps even more than Bristol Bay. All of the data is important to someone, even if not all the data is important to everyone. Difficult process because something which is important to someone will need to get dropped. Need to think about "nice to have" vs. "need to have".
- appreciate comments on "target" -- out of scope of this workshop, but still critical. Bigger than just this issue. We need to have some way of getting to more dependable, reliable annual process. For past 5-10 years, TF program is operated in piece-meal fashion. This is unsustainable for PSC, for PSC staff, and ultimately everyone here. Need to consider other solutions – i.e., can we use dollar-cost averaging (catch more fish in abundant years to bank funds)?
- complex issue – want more/better information, but that costs more and cost is a constraint. Frustrations with TF have been from seeing wild swings in data – feel that better information could be gathered by better addressing how to account for variation from wind/weather/tides, etc.
- thinking about scenarios, and what type of information do I want in different situations. The idea of less TF in lower abundance and more in high/med is not comfortable – I want to have more precisions in low abundance to have more confidence around decisions made when near the threshold of having/no having fisheries.
- the logistics of implementing test fisheries will be very important to consider.

- lots of variation on perspectives on information other than modeling (came up in workshop 1), glad to see that being captured. No silver bullet. Important to have all the information documented and recorded to inform decisions. The issue of test fisheries is very important to many more people than just those in this room.
- in workshop 1, evaluation framework was much more conceptual – think the work has come together nicely since then. Good to see.
- timeliness of information, run size estimates and precision of diversion rate are all very important. Understanding abundance in Area 7 is critical (location of most of US fisheries), and doesn't always align with data from Area 20.
- good summary. Lot of dimensions and lot questions that could be tackled. Hope that in the next few hours, answers to a lot of these questions will come up. But want to make sure that other questions that didn't get addressed or come up new, don't get lost.
- interested in discussions of more seaward options. Looking forward to hearing about the work that came up.
- not much to add
- concerns going into Workshop #1, don't lose ability to run TF and listen to those on the water. Echo Jamie and Bob's comments (that all of the information is important to someone, including many not in the room)
- not at first workshop. All interested in getting information while reducing cost. Lots of discussion of utilizing data/info from FSC/C&C and commercial fisheries – fruitful to pursue as they are already running.
- looking over Workshop 1 outcomes and preparing for this workshop, conclusion is that the TF program we have is not fatally flawed. Raised at first workshop too. Don't have a giant wound we are trying to fix. Ability to move toward fixed program under different scenarios would be tremendously helpful to PSC – don't want to have prolonged, in-depth discussion every year from scratch for what to do that year (consumes lots of time and resources). Agree with Bob – nice to have vs. need to have. Other issue is that there is no overarching TF policy between US-Canada – makes it hard to determine how much money is available each year. Might be putting cart before horse – define best program before knowing funds available?
- didn't like that Activity #3 wasn't addressed – good opportunities for additional information from other sources. Commercial fishermen have ability to fish where they want, based on tides and weather, therefore ignoring those factors must impact TF. Another issue – the PSC always disallows anecdotal information from being incorporated, but certainly cases where info from consistent sources could be incorporated into our methodology.
- not at first workshop. Lots of discussion of tides/weather. Fraser River TF is based on that.

- two issues – cost constraints and then how do you add other information into the system overnight – this requires more added cost, more uncertainty, and the need to run duel approaches for a while to compare, etc. The current system didn't arise out of no thought.
- very interesting/insightful first workshop – ultimately seem to be looking at how we can get similar/better information for less cost, or not that much erosion of information.
- not at first workshop, but time to prepare and read for this one. Think having these lines of communication is open, is very importatnt. All issues raise likely said toerh times. Also , every year we have more and more data. This is very valuable to help us move forward.
- workshop has been very good for looking at overall set of TFs. PSC has often looked at individual. Very valuable to look at entire suite all at once. Want to say more about catchability – tides/weather – agree that it has a big impact, but one thing to understand is the difference between the fact that it has an impact vs. being able to use it to make predictions – some years have very good relationships for predicting catchability, but then relationships fall apart in other years. Don't know which year you're in.. Similar with currents as well. [missed more]
- not at first workshop. There is an important education component – those fishing in Johnstone know all about winds/tides/currents, but people making decisions and using models don't understand that. It has taken years/generations to understand details of these relationships in a specific areas. How can this be incorporated into the TF program. First workshop = model for all TFs, now fitting TFs into a model.
- echo many others. Want something we can continue to use every year and not have to rebuild every year.
- test fishers do know the local area and have discretion to make decisions in where to fish in different conditions. Can make decisions about where to go based on conditions of the day.
- tides are critical. Frustrated that we are trying to develop a program without understanding the overall cost, and not discussing costs.
- concern with costs – will "refinements" get us to the necessary cost reductions, seem more like tweaking. Do we need to build something from scratch? Concern with desire to get more info and better and more specific, but without guaranteed ability to be able to support the program
- not at first workshop. Pick up on Tony and Chris Cue re: incorporating tides and weather. Current system is based on assumption of random sample in an area that is representative, or that variation will cancel each other out. Want to see design of a program that is more representative, based on knowledge from experienced fishers such as Tony and Chris – do analysis on where to go to be more systematic.

Presentation on alternative marine test fishery configurations (Research activity #5)

Catherine Michielsens

- see slides

Comments:

- participated in Gordon Group test fishery – lot of time spent sorting through fish, which would lower catchability
- re: Naka vs. Round Island – using same window?
- yes, using same days (but offset for travel time) – this is a fair comparison

Presentation:

- Naka Creek catchability is based on relationship between Naka CPUE and Round Island CPUE
- More thorough comparison requires running TF longer, for several years

- Area 13 PS
    - Two examples shown – one year Area 13 overestimates, other year Area 12 overestimates
    - Average is better predictor than picking one or the other
- Including Area 13 CPUE
    - Varies whether it increases/decreases run size error
    - But in some years it offers a BIG improvement – and those tend to be low abundance years
    - Thus conclusion – Area 13 is most valuable when abundance is low
- Area 20
    - Not much benefit of having 2nd boat
    - Biggest impact is assumption used for catchability

- Overall
    - Area 12 and 13 – two sources provides more independent information
    - Highly correlated sources (e.g., Area 20) both tell same story
- Conclusions – see slides
    - Could use relationship between A12/A13 could be used to use Area 12 data to predict catches at Naka Creek
    - Using two time series that are independent and not correlated gives much better information than

Comments:

- re: Gordon Group, did you combine with the Area 12?

- no, only had data for 2005; comparisons are limited to data availability

- Area 13 didn't provide better estimate of abundance; but don't want to lose sight of need to have independent TFs. Late run may be very low, and combined TF might perform.

- Area 13 is very valuable second source of info in some (but not all) years of low abundance.
- Area 13 is higher catchability, but have slightly higher bias – may be associated with greater influence of winds and tides in A13 than A12

- re: Area 2W analysis – has not been much fishery recently; but has been some fisheries in a couple particular years.
- didn't analyze that data, but rule still applies – wider area yields more variability in catchability
- push has been that in some years the earlier data provides a qualitative indicator. Can show that run is still continuing.
- can be useful in some years, but if you look across the years then you see that even qualitatively it doesn't make a good indicator. Sometimes you see later or earlier timing than in the Fraser.
- highly variable, depends on where fish make landfall; Area 104 can be hit or miss
- still think there is opportunity to make more use of this information; e.g., in Adams years there is consistent catch off Haida Gwaii – need to explore this.

- there is also a safety aspect to having 2 boats – concerning to have only one boat off the coast at night (whales, boats, submarines, etc.). 2 boats also have better chance of encountering fish – changes effectiveness. Also daily rate (charter costs) changes based on number of days

- Area 20 comparison was under low diversion, what about higher diversion?
- analyses done on all data, conclusions apply across all years, just showed examples from low diversion

- Area 13 comparison – what about the run size that we were managing to (vs. predicted run size)
- didn't put on the graph, but have that data too
- are we trying to get the TF to match the reconstructed run size
- depends on what you are interested in – daily abundance, or run size estimate. We don't want our run size estimate to be disproportionately affected by individual days of particularly high or low catch. Area 13 usually doesn't make much impact on run size, but can be very important for some years of low abundance – additional confirmation.

- decrease in error doesn't mean confirmation of low abundance, could be confirmation of high abundance too? i.e., what about directional component?
- correct, but the years in which the error was actually reduced were years of low abundance, so it was most helpful in confirming low abundance

- *[missed – about some of caveats]*
- Used A12/13 combined with A20 to compare to complete abundance (didn't have to parse out abundance by approach)

- is Naka Creek self-supporting?
- closer than others, but doubt it is actually self-supporting
- may make cost of expanding not as expensive

Presentation on seaward information (Research activity #4)

Catherine Michielsens

- see slides
- Focuses ONLY on value to in-season run size estimates
- But often difficult (common to many analyses) to do analyses when we don't have much data
- Analysis gives BEST CASE scenario, IF we had earlier data that is JUST AS GOOD QUALITY as our current data, then what would be the impact

Comments:

- interested in confidence in in-season management decision. We often wait until we have strong confidence. If we have confirmation 2 days earlier, then that could be critical – could make fishing decisions two days earlier.
- [unsure if accurately captured] – but also have to consider bias and precision (e.g., Gordon Group); question is good but that is interested in daily abundance. This is focused on how much additional value overall – i.e., better estimate of run-size.
- Greatest source of uncertainty – don't know what seaward abundances are still coming.
- have you done analysis on impact of no marine TF, and just use hydroacoustics
- have done that analysis, as part of other SEF project, but not presented. Conclusion – TFs do improve estimates.

- if seaward TF doesn't make much difference, and more seaward hydro-acoustics with doesn't make much difference, can we conclude that moving from Mission to Qualark won't make much difference?
- that would start to erode quality of Mission data (affects assumption of known-without-error) and lose 2-3 days of data – will greatly deteriorate quality of estimates. Replacing high quality data with something of less quality and even later. Most critical aspect of entire program is to estimate when the run turns (peak).

- but data is available only few days later
- but delay is at most critical time for fishery decisions

- in years of higher abundance, do we have higher certainty from TF? Is catchability, expansion lines, etc. more accurate at higher abundance?
- tried to look at run-size and catchability – didn't find any clear relationships. Haven't found any other relationships between quality of TF and run-size.

- re: "Mission abundances are assumed to be accurate without error" – but actually there is error – it is not at mouth of river. Have to account for Pitt because it is before mission. Moving to Qualark would increase error because then we would also have to account for Harrison, Chilliwack, for which you'd only have estimates from TFs.

Presentation on representativeness of purse seine TFs in Areas 12 & 13 (Research activity #6)

Brendan Connors

Part 1 – can set locations be adjusted to improve daily abundance estimates

- Compare CPUE for each assessment set to reconstructed daily abundance
    - Looking for bias and precisions
- Area 12 test locations
    - Focused on subset – most frequently used sites (typically more than 100-150 sets over period of record)
- Bias / precision – on average, across all years
- Slide 10 – bias in daily TF CPUE when site is included

Comments:

- do the sets include zero catches?
- includes set that were included as assessment sets – means there are a few zero catch sets (rare), but other sets were sometimes excluded from assessment sets for other reasons (i.e., not just excluded for this analysis, but excluded from assessment sets used by PSC)
- Cracroft and Sophia/Splash are the only two open set. All other are beach sets. That will affect data greatly. Also need to understand that tides move across Johnstone straight and push fish past Sophia/Splash
- why isn't Fines Beach included – it should be
- Chatham Pt is fished at a specific tide; that's why it does so well. All sites in Area 13 TF are beach sets (except McMullen Point)
- Area 12 outlier sites – both unique in terms of geography and the type of set

Part 2 - ITQ catches in Area 12/13 as data supplement to existing TFs

Comments:

- ITQ follow TF in timing, that's why TF catches more – they have full coverage, whereas commercial can't fish until after TF
- does logbooks include data from all vessels?
- pretty decent submission data
- maybe 80-90%?
- Jim Cave's work didn't have all the end of season logbook data. He found relationship with end of season logbook data in area but didn't find a relationship with data in season.

- keep in mind the year had much abundance, so some fishers did open sets in strait rather than wait for beach tie ups
- keep in mind that ITQ is competitive; boats are following to each other
- some boats fishing for companies have multiple licenses/quotas, but other boats have only fixed quota

- it is valuable to understand why there is a difference (between catchability in TF and ITQ fishery), but understanding relationship means we can correct for this and answer the ultimate question of whether we can use the ITQ information to augment TF

- in that year, there were also fishers that gave away fish – don't have the quota, but encouraged not to throw away and there is no place to record "fish given away". Not reflected in in the logbook of the fisher that caught fish, but it is trusted (but not known) that the receiver would document it as catch.
- all this brings questions about the extent to which commercial data can be used, because there are so many unique issues going on
- means you should do more analysis and consider the types of fishers and what they have done; perhaps stratify further, etc.

- grew up in fishery where commercial fishery provided the most comprehensive/accurate estimate of what the abundance is – Test fishery fills the gap, but we want to proceed toward wider, more comprehensive use of commercial fishery, with more data.

OVERALL QUESTIONS (both topics):

- Cracroft and Sophia/Splash are open sets, but is being on the other side of the strait a more important factor?
- open sets always catch less. Important impact of tides – strong tides push fish past Sophia – need to address effect of tides

- *[missed discussion about daily in-season reported data versus end-of-season logbook]*

- would be very difficult to get 100% compliance, but might be other way to get some of the data – maybe subset, or have some companies have some of their fishers report consistently

- re: comments about the tidal dependency of Chatham Point, does that affect representativeness
- true, but Brian choses sites based on tides, so other sites have tidal dependency

- are you using all ITQ from Area 12 or Area 13, or only near the TFs. You are missing a lot of information outside of those days. Would have much better indication by taking data across whole area from first set or two of the day – first sets of the day are the biggest, best sets.
- but don't need full spatial coverage – want to estimate daily abundance at certain location; concern is whether the data is a good indicator. But I am more interested in idea of using first sets.
- first sets are always the best; fishermen fight for priority

- data is not reported by set, so that data is not available
- we tried to get set-by-set reporting in past and was not well-received by industry
- seems like more work needed to see how we could develop this indicator; perhaps with certain fishermen reporting sets.

Presentation on current suite of in-river test fisheries (Research activity #7)

Keith Forrest

- Characteristics of each TF
- Compare implications of keeping 2 TF and dropping 1 TF

Comments:

- have to also consider that modifying Albion TF would have implications on the original designed purposes for Albion
- "estimated cost savings" is just direct elimination of operating costs (but not factoring in increased expenses to mitigate data)?
- correct

- work on comparing CPUE for species under different TFs
- have done some of this, and results are variable – sometimes they line up quite well and other times not

- dollar savings, does that include money made on fish?
- that is the total cost, but doesn't include revenue
- Albion makes revenue on Chum

- pretty much use almost all the killed fish at Whonnock for sampling; would have to pick up catch elsewhere
    - Would also have to hire other staff elsewhere

- would be more helpful to have net cost (operating minus revenue fish)
- in Whonnock case, revenue might be about 50%
- "cost" is the cost of implementation, but isn't really "savings" because under current operation you have revenue to offset the cost

- issue is that we don't have any quantitative estimate of value of information for this, but just qualitative (unlike other refinements), so it's hard to compare/evaluate
- these TFs have benefit for other species too, so it would be hard to allocate what the value is just to sockeye/pink

- Albion is biggest cost, but that is external to Panel TF?
- Yes, budget from other funds

- length of net differences?
- based on river traffic and geography

- seems like modifications of removing TF will just offset/move costs to elsewhere – each of these TFs was designed for specific purposes that then has to be mitigated elsewhere if it is lost. Is it really worth doing further analyses to better understand costs?

- how long has Area 12 Seine being run 7 days per week?
- since almost 1997
- any change in methodology
- only thought is change from fishing north to south

Presentation on alternative uses of test fisheries data (Research activity #2)

Alex Hall

Comments:

- Do the perceived purposes of the data line up with survey results?

  - generally, but have to recognize also that that isn't what the respondents were being asked – questions were about how they use the data, but just that some of the responses were more generally about the value of the data to the TF program
- Didn't asks what people would do if they didn't have the data – i.e., opportunistic use, but would do something else if they had to
- Gulf troll is important for understanding potential opportunities on Lates
- Area 12 is important for even-year pinks (NVI)

Other refinements to test fisheries program

- Table explained
  - Structure and organization
  - Where the info came from – i.e., refinements extracted from results of subgroup work during Workshop #1 on developing "portfolios" of TF for different scenarios

New refinements to and needs for test fisheries program

- Silent generation (on post-it notes)
- Roundtable to share individual thoughts with plenary
- Post-its stuck on flip charts
- Summarized overnight by theme and distributed with group on Day 2

1 – SEF proposals

- Sonar for late run in Gulf
- Re-do Brendan analyses with standardized residuals and correlate with environment
- Evaluate Naka Creek, including specific catchability
- Add additional sets to assessment sets – research project, see if daily estimate can be improved

2 – Get info in future season for collecting tides/weather data during test fishery

- Start with qualitative indicator before determining how to best quantify
- Can we identify TFs that are agreed to not be changed

3 – actual net cost of individual fisheries against value of the information, possibly for all TFs

- Should we have a minimum TF plan (i.e., low abundance/Pink; or maybe it should be higher). Spend a lot of time discussing each year. Bette to have starting point
- More communication with commercial sector; even with analyes that have been presented, could have been improved

4 – need to get most $$ from TFs (how is it sold, does it meet market standards, etc.)

- Need to get info sooner (i.e., from fishers)

5 – *[missed most due to noise]*

- Sonar instead of Troll in Gulf

6 – need to utilize data from all fisheries that are occurring; need to create realistic methodology within fisheries to allow data to be collected

- *[missed some]*

- New model with tides/weather to mediate impact of sudden increases/decreases
- Evaluate Naka Creek if it was operated as long as Round Island, then replace

7 – doesn't seem like restructuring [in-river] TFs would be very useful – zero sum game

- Suggestion from first workshop, from industry – landing levy to pay for TF (done in other fisheries)

8 – tribal reefnet; tribes usually catch small amount, but reefnet could be used over longer season with small amount to characterize run size and timing

- *[missed some - importance of Area 7]*

9 – incorporate tides, weather, behaviour

- How to use FSC fishery data

10 – lot of opportunity to look at tides and weather – have built catch database, but need tide/weather database (data might even be accessible historically)

- Need to get more thorough evaluation of in-river fisheries in order to assess whether to modify
  - Can't consider changes independent of hydro-acoustics review

11 – use commercial fishery data to augment, if you can get same quality; is there way to get better in-season (requirement, incentives for voluntary)

- Tides and weather

12 – environmental drivers of catch; structure exists to be able to do that analyses – how would you characterize, and then can you use it to improve run size assessment

- Commercial data – opportunity to explore optimal use of in-season data; how to get benefit of these data; what is possible, how to better collect

13 – reacting to possibility of removing reefnet – all three locations are important to give indication of fish in US area, plus genetic sampling

- Want to analyze the use of reefnet data for predicting US catches

14 – re: seaward hydro-acoustics and Catherine's presentation – don't know that much more work should be invested in this area. Good to have considered, but doesn't look beneficial.

- Area 20 2 boat vs. 1 boat – seems relevant potential improvement; want better estimate of real savings

15 – confirm revised data in ITQ fishery; if appropriate consider using these data

- More analyses of in-river fisheries
- Don't see much value in more discussion on seaward indicators
- Don't see much use of discussion on marine sonar
- Tides/weather are important, should try to consider – Area 13 is important to this

16 – re: timely logbook information – Jim Cave always bugging to improve this situation; have SEF proposal to get subgroup of fleet to report logbook daily, and can be done by set; already have loggers on [36-38] boats, good subset with ability to report daily

17 – *[missed some]*

- Flexibility to test fishers to choose location of some sets (i.e., if they see fish offshore, or know fish are elsewhere)
- Add "freelance" TFs that have freedom to fish where they choose
- Mandatory set-by-set catch reporting – either subset or full fleet with incentives (use % of TAC to reward compliance)

18 – seem to have ruled out some seaward options (e.g., Area 104, and if not what do we need to further analyze – when is it useful, how can you predict

- Rule out changing Albion – outside jurisdiction
- Design 1 or 2 collection schemes to test in ITQ fishery (with incentives); have collection of LOCAL environmental data (may be more nuanced than regional data); apply different methods to subsets (will never get full fleet participation)
- Talk a lot about contribution to precision/bias in estimates – but how do we assess confidence in the estimate, is there a way of measuring this?

19 – set up minimal TF programs based on pre-season forecast, that can then be modified as necessary

- Complete assessment of Area 12/13 sites with removal of those sites (redo historical expansion lines, etc.)

20 – value in better understanding cost/benefit of cottonwood (incl. various other expenses over time/post-season)

- Consider removal of TFs that are only used for domestic purposes – how can info be otherwise acquired

21 – explore possibilities at Albion (not ready to walk away from that idea, have used sockeye net there before)

- Further analysis of value of information from Cottonwoond and possible removal
- Standardize TF design for different types of years, instead of re-discussing every time
- Explore opportunities for set-by-set data from Area 12/13 commercial fisheries
- Explore consequences of different set types
- Incorporate tide/weather info, and make data searchable
- Explore Naka Creek further, could be done with commercial TAC

22 – re: in-river – explore costs and potential savings, seems like there should be opportunities

- Re: seaward – concrete assessment is difficult because they are data limited; may want to continue to explore, before closing door – explore through SEF projects
- Further consider coordinated FSC – want more decisive conclusion
- Area 2W has always been scattered/piece meal – then trying to see what we can conclude; could consider 4-boat troll moving northward from NVI, for qualitative indication – maybe not for run-size, but additional info for helping with decisions-making
- Need to further explore utilization of FSC data in GG and Johnstone Strait

23 – need to invoke regulatory change for accurate and timely reporting of data; potential exists, but don't know exactly what's caught – regulations are almost there (e.g. e-log program). Need carrot and stick.

- Area 2W – strongly in favour of furthest at-sea eye on stocks; could be opportunities at little cost (dual licenses in Area F/H – regulation could allow some portion to take their F/H allocation in 2W)
- Think about re-configure one of the Johnstone Straits and allow them to optimize their catch according to tide/weather – would be supplemental boat
- Need to incorporate "AFS" *[FSC?]* data into our models

24 – want consistent location for test fishery, not flexible, but use local knowledge to design better program

- Haven't talked much about stock ID – think we have poor representation and could get better data; FSC could be used to get better SID data, especially on shoulder seasons
- Want to see analysis on incremental value of adding each fishery – proposed analysis approach would be to start with nothing, add test fisheries individually, then combinations – that's how we best understand the value that each TF is contributing

25 – need to figure out how to add ITQ data into TF program

- Need to incorporate tides/weather
- Don't need reporting from every boat – can get lots of data from companies by 8am next day
- Have to address predator issues that are becoming a bigger issue (e.g., last year's Chum)

26

- Roller bay
- Area 4/5/6
- Area D (multi-boat?)
- Use rec fisheries instead of gulf troll
- Big idea – can we just run GNs to get sufficient idea of run, then commercial fisheries come online
- Can we increase TFs as needed, especially re: decisions on TAC

27 – *[missed first part]* – ITQ data?

- Retrospective river
- Naka and Gordon Group catchability estimates
- Good to see benefit of coordination of "A12/13 fisheries

28 – provide range of revenues for in-river TFs

- *[missed – re: SEF]*
- SEF – Gulf assessment of delayed lates
- Ongoing SEF – monitoring tides/currents, plus tagging to see how behaviour interacts with tides/currents

Workshop Day 2 – Opening

Catherine Michielsens

- short talk – value of test fishery vs. hydro-acoustics vs. combined

Comments:

- [missed substantial portion of discussion]

- second graph shows that big uncertainty is around how much more is to come. That's why increased precision of amount passing through doesn't necessarily
- Knowing what amount of fish you have in hand, but doesn't allow you to know about what fraction you've seen

- depends on when we think 50% date is; if it is X, then we have this many to come; but if 50% date is this, then we have this to come
- when are we confident that we have seen the peak, often not until Mission observed peak

Subgroup-discussions on priority refinements

- Discussion in subgroups
- Recorded in worksheets

Plenary Debrief

Participant update: 20 participants remaining (of 32) – due to early departures for travel needs

- Group debrief – recommended/proposed refinements (but not details of rationale) reported back to plenary
- Notes recorded on flip charts, details in subgroup worksheets
- Conclusions re: commonalities & next steps summarized at top of proceedings document

Appendix A: Workshop Agenda

PSC Fraser River Panel

Improving Fraser River Test Fisheries and Run Size Estimates: Workshop 2

Workshop Agenda

May 31 - June 1, 2017

Fisheries and Oceans Canada
#200 - 401 Burrard Street, Vancouver BC
https://goo.gl/maps/GLW7Jq8X33n

Project Leads:

Mike Lapointe
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Workshop Facilitators:

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Alex Hall
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Project Background and Goal:

The Pacific Salmon Commission, or its predecessor the International Pacific Salmon Fisheries Commission, has operated test fisheries to obtain data required to inform bilateral decisions of the Fraser River Panel since the 1960s. The information gathered from these test fisheries is regularly used in conjunction with information from the in-river hydro-acoustics programs to provide estimates of timing and in-season run size of Fraser River sockeye salmon management units.

The Fraser River Panel and Pacific Salmon Commission are undertaking a review of test fisheries to identify opportunities for refining the test fishing program in a way that ensures it can provide high quality information, minimize costs, and minimize fish mortality. As part of this study, two workshops are being held to gather technical input from scientists, decision makers, First Nations/Tribes, and stakeholders from both Canada and the United States. This workshop is the second of these two meetings.

Workshop Objectives:

(5) Review reflections that emerged from workshop #1 (performance criteria, strengths / limitations of current program, critical needs, priority research activities);

(6) Review findings from priority research activities completed since workshop #1;

(7) Develop suggestions on how current test fishery program could be refined based on key performance criteria (value of information, cost, and fish mortality); and

(8) Gather input on immediate, near term, and longer term needs to inform future decisions about possible refinements to the current test fishery program.

Anticipated Outputs:

- Common understanding of problem context, current program, and research findings since workshop #1;
- Suggestions for the Fraser River panel to consider in its decision to refine the current test fishery program based on key performance criteria (value of information, cost, fish mortality); and
- List of future needs / activities in the immediate, near, and longer term to support decision making about possible refinements to the test fishery program.

Pre-Workshop Materials:

- Summary of potential refinements to test fishery program that emerged from workshop #1
- Summary of findings from priority research activities undertaken since workshop #1

Day 1

Approx time	Topic	Contributors
8:00	Arrival – *Participants will need to allow some time to sign in with commissioners on 2nd floor*	
8:30	Welcome and introductions	Jennifer, Lorraine, Participants
8:45	Overview of agenda	Marc Nelitz
9:00	Context and scope of this review	Jennifer Nener
9:30	Overview of workshop #1	Alex Hall and Mike Lapointe
10:00	Roundtable on perspectives of participants	Participants
10:40	Break	
11:00	Presentation on alternative marine test fishery configurations (Research activity #5)	Marc Nelitz Catherine Michielsens
11:30	Presentation on seaward information (Research activity #4)	Catherine Michielsens
12:00	Lunch (provided)	
1:00	Presentation on representativeness of purse seine test fisheries in Areas 12 & 13 (Research activity #6)	Brendan Connors
1:30	Presentation on current suite of in-river test fisheries (Research activity #7)	Keith Forrest
2:00	Presentation on alternative uses of test fisheries data (Research activity #2)	Alex Hall
2:30	Break	
2:50	Potential refinements to test fisheries program from workshop #1	Marc Nelitz and Alex Hall Participants
3:20	New refinements to and other needs for test fisheries program	Marc Nelitz Participants
4:20	Recap of Day 1	Marc Nelitz
4:30	Adjourn	

Day 2

Approx time	Topic	Contributors
8:00	Arrival	
8:30	Overview of agenda and key outputs for Day 2	Marc Nelitz
8:40	Sub-group discussion around priority refinements to improve value of information	Sub-group work, supported by ESSA facilitators
10:10	Break	
10:30	Sub-group discussion around priority refinements to reduce financial cost	Sub-group work, supported by ESSA facilitators
11:30	Sub-group discussion around priority refinements to minimize fish mortality	Sub-group work, supported by ESSA facilitators
12:00	Lunch (provided)	
1:00	Sub-group discussion around tradeoffs of priority refinements (i.e., refinements that provide the best balance across improving value of information, reducing cost, and minimizing fish mortality)	Sub-group work, supported by ESSA facilitators
2:15	Break	
2:35	Reporting back into plenary on sub-group discussions	Sub-group reporting and plenary discussion
4:15	Recap, next steps, and closing remarks	Marc Nelitz Jennifer Nener Lorraine Loomis
4:30	Adjourn	

Appendix B: Workshop Attendees

1. Marc Nelitz
2. Alex Hall
3. Catherine Michielsens
4. Erica Jenkins
5. Brent McCallum
6. Peter Sakich
7. John Murray
8. Les Rombough
9. John Field
10. Ben Starkhouse
11. Kelsey Campbell
12. Mike Staley
13. Aaron Dufault
14. Brendan Connors
15. Jack Giard
16. James Dixon
17. Jamie Scroggie
18. Ron Goruk
19. Mike Hawkshaw
20. Chris Ashton
21. Mike Lapointe
22. Bob Conrad
23. Lorraine Loomis
24. Kirt Hughes
25. Jennifer Nener
26. Les Jantz
27. Mike Griswold
28. Tony Roberts, Jr.
29. Brian Assu
30. Keith Forrest
31. Chris Cue
32. Ann-Marie Huang
33. Rob Morley
34. Pieter Van Will

Appendix C: Sub-group Worksheets

GROUP 1

PART 1 – MOST PREFERRED REFINEMENTS TO IMPROVE VALUE OF INFORMATION

(1) What is the preferred refinement?	*(2) Why is this refinement preferred? How will the refinement specifically improve value of information?*	*(3) What potential barriers affect feasibility of implementation?*
Catch reporting comm/TF timely and resolution set and location	• More update information • Better reconstructed abundance	Enforcement compliance auditing
Need samples from FSC fisheries Cottonwood FSC fishery	• Increase sample size • marine/ in river	• Getting samples – logistics • Design of the fisheries • May be delay
One boat instead of two		Logistics Not as reduced costs
Naka Creek • Value now is poor • Explore if paying for test fisheries through the use of fish		
Don't delay start much as it impact catchability Better to stop earlier	• In-season catchability	
Use of C &S fisheries instead of 4B5 • small bite fishery • sockeye encounter		
Qualark	• Move the information sooner in season	logistics
Keep all set fish		Not be allowed to keep them
Test fishing sites	• Remove 2 sites	

PART 2 – MOST PREFERRED REFINEMENTS TO REDUCE FINANCIAL COST

(4) What is the preferred refinement?	*(5) Why is this refinement preferred? How will the refinement specifically reduce financial cost?*	*(6) What potential barriers affect feasibility of implementation? What information would be lost?*
Cut Area 13 on high abundance	• Use ITQ data • Only beneficial in low abundance years • Harvest fishery instead of test fishery/ contract them	Does not maximize pay fish
Stop seine fishing sooner Flexibility at the backend of the season	• Reduce cost • Fisherman can partake in commercial fisheries	May not be suitable for fisherman
Naka Creek 4B/5 • Delay Area 20	• This year's set-up	
Not more cost reductions unless value of alternatives have been established		
Get rid of Qualark hydro-acoustics & test fishing		
Gulf troll		Need work on alternatives

PART 3 – MOST PREFERRED REFINEMENTS TO MINIMIZE FISH MORTALITY

(7) What is the preferred refinement?	*(8) Why is this refinement preferred? How will the refinement specifically minimize fish mortality?*	*(9) What potential barriers affect feasibility of implementation?*
Gill net test fisheries Naka Creek 4B/5		
Reduce mortality when it counts • Low abundance years • harvest in high abundance years		
Use tax on landing, better piece To reduce payfish needs		Structured as test fishery "Cottonwood FSC fishery"
Convert test fish to FSC fisheries		
Marketing improvement of test fisheries		

PART 5 – UNACCEPTABLE REFINMENTS TO TEST FISHERIES PROGRAM

(17) What refinements are unacceptable?	*(18) Why is this refinement unacceptable?*
Mission Whonnock Cottonwood	Research to ensure refinement does not impact value of data
A12/A20 (1 boat) boat gillnet purse seine If you run a test fishery run at least for 12 days to get a season catchability estimates	Just unacceptable now but can be acceptable in additional work is done and it can be proven that it does not impact core assessment results

PART 4 – MOST PREFERRED REFINEMENTS THAT PROVIDE BEST BALANCE ACROSS PERFORMANCE CRITERIA

*(10) What refinement provides the **best balance** across performance criteria?*	*(11) How does this refinement affect **value of information?***	*(12) How does this refinement affect **financial cost?***	*(13) How does this refinement affect **fish mortality?***	*(14) **When** could this refinement be implemented? In 2018, 2019-2020, or 2020+?*	*(15) Are there any **barriers** that might affect implementation of this refinement (e.g., knowledge / data gap, capacity constraint, funding shortfall, need for collaboration)? Be specific.*	*(16) **Why** is this refinement preferred?*
Timeliness and resolution of catch reporting in all fisheries comm & FSC	Better reconstructed abundance & timeliness of management decisions	Increase in cost for other players	same	ASAP	Logistics, compliance, research needed	
Redundancy elimination Qualark/Mission 12/13 – in years of high abundance 1 / 2 boats Naka /Round Island – Naka Research needed	No confirmation	Major cost reduction	Reduce fish mortality	ASAP	Hydro-acoustic review Political	
Cottonwood FSC fishery	Same	Reduced	None/reduced	Pilot in 2017/2018	May not make sense Research needed	
Evaluate sample design (200 – 100 fish)	Maintain value at lower costs	Reduce redirect	May be reduced	Thursday	May require additional analysis /cost	
Money Improved value of fish Marketing Alternative funding sources	None	Same but increased revenue	Reduced	2017	Policy Availability of fish	

GROUP 2

PART 1 – MOST PREFERRED REFINEMENTS TO IMPROVE VALUE OF INFORMATION

(1) What is the preferred refinement?	*(2) Why is this refinement preferred? How will the refinement specifically improve value of information?*	*(3) What potential barriers affect feasibility of implementation?*
Which test fishing locations provide the most information Consider eliminations those less effective (J.S.T)	• Improve relationship with consistency of abundance to CPUE	PSF staff time
Systematic reporting of environmental conditions these data are reported by the observe sheets	• Better interpretation of data	Should at no additional cost Data is collected Analytical time
Review sampling design refinements with test fishers, Catherine, Carmen, other local people (JST)	• Improve relationship with consistency of abundance + CPUE	Time
Improve commercial data reporting / involvement	• Improve timing/ abundance estimates	Infrequent commercial opening Money Willingness to participate Degree of prescriptiveness
Get more information from FSC fisheries (GG)		
Add sockeye mesh size to whonnock to increase sockeye samples for SID GN mono net	• Increase sockeye sample size for SID	Cost & evaluation of impacts to existing test fishery Need to run parallel programs to understand CPUE
2W F & H dual licence	• Get SID & CPUE and possible database to get seaward time/ abundance	Regulation to limit bts
4B, 5, 6C, GN test fisheries.	• value	Analysis with A20 GN

PART 2 – MOST PREFERRED REFINEMENTS TO REDUCE FINANCIAL COST

(4) What is the preferred refinement?	*(5) Why is this refinement preferred? How will the refinement specifically reduce financial cost?*	*(6) What potential barriers affect feasibility of implementation? What information would be lost?*
Design program based on forecast. (< ~ 4 X 10^6 runsize seems more important /need for data)	Efficiencies Reduce the o/a cost of the program	Need for flexibility Evaluate forecast in terms of TAC
ID suite of t.f. required for key decisions	Efficiencies with respect to panel management and fish opportunities	Need for flexibilities
Improve catch upriver and eventually eliminate Cottonwood	Improve SID for Mission Reduce cost of Cottonwood	Being sure implications of making changes to other t.f. SEF to operate parallel programs
Increase profits from t.f. sales	Increase revenues	Increase cost associated with expertise to market etc. handling fish
A29 troll drop	Lack of fisheries & model relationship insufficient	Alternative technology program costs

PART 3 – MOST PREFERRED REFINEMENTS TO MINIMIZE FISH MORTALITY

(7) What is the preferred refinement?	*(8) Why is this refinement preferred? How will the refinement specifically minimize fish mortality?*	*(9) What potential barriers affect feasibility of implementation?*
Minimize test fishing schedule as required for management	Efficiencies of scheduling t.f. minimize catch	Need flexibility to react to management
Use of "other" (FSC) fisheries to collect assessment data	Reduce sample size requirement from t.f.	Willingness to participate
Optimize gears to minimize mortality re PS. RN vs. GN	Reduce GN mortalities	Impacts on assessment data
Live sampling	Reduce # of fish killed for samples t.f.	Time required to handle fish

PART 5 – UNACCEPTABLE REFINMENTS TO TEST FISHERIES PROGRAM

(17) What refinements are unacceptable?	*(18) Why is this refinement unacceptable?*
Hydro-acoustics @ Chatham Pt. (no more discussion required)	Southern resident killer whales Feasibility, tides, spp. comp., SID
Dist 104 (no more work required)	Poor relationship
Wouldn't want to see "key" assessment programs impacted/compromised	To ensure data quality, timely for management purposes

PART 4 – MOST PREFERRED REFINEMENTS THAT PROVIDE BEST BALANCE ACROSS PERFORMANCE CRITERIA

*(10) What refinement provides the **best balance** across performance criteria?*	*(11) How does this refinement affect **value of information?***	*(12) How does this refinement affect **financial cost?***	*(13) How does this refinement affect **fish mortality?***	*(14) **When** could this refinement be implemented? In 2018, 2019-2020, or 2020+?*	*(15) Are there any **barriers** that might affect implementation of this refinement (e.g., knowledge / data gap, capacity constraint, funding shortfall, need for collaboration)? Be specific.*	*(16) **Why** is this refinement preferred?*
Balancing the t.f. schedule around the forecast and TAC	Focus on critical part of the return	Reduces overall cost, maximize revenues	Reduces mort. on weak stocks early and late	ongoing	0	Optimizes the use of fish/money and information
Review PS t.f. exp design. Including locations, environmental info, "experts"	Improve relationship between CPUE & abundance ≈ better run-size est	Could improve cost effectiveness	----	2018 – requires some planning etc	Analytical time participation	Low cost Improves relationship between CPUE and abundance
Consolidation of lower Fraser GN t.f. without comprising data integrity	Increase sockeye SID samples sizes	May depend on final design. Likely reduce costs	Hopefully increase fish mortality (sample sizes)	As soon as 2018 to be assessed over 3 – 5 years	Need to understand the implications of transition • SEF study on adding panels at Whonnock &/or Albian	Cottonwood t.f. has become increasingly compromised Traffic, industry, below North Arm
Explore opportunities of involving / including / getting data from FSC, C&S, commercial fisheries, recreational	Increase data qualitative data initially	T.B.D. could reduce t.f. costs	Could reduce t.f. mortality	Sooner than later qualitatively, later than sooner quantitatively	Agreements Willingness to participate	More informed user groups. Fill gaps & provide more overall data

GROUP 3

PART 1 – MOST PREFERRED REFINEMENTS TO IMPROVE VALUE OF INFORMATION

(1) What is the preferred refinement?	*(2) Why is this refinement preferred? How will the refinement specifically improve value of information?*	*(3) What potential barriers affect feasibility of implementation?*
More coordinated consideration of sites used in Area 12 and 13 – to optimize Area 12 and 13 purse seine test sites	• improve precision of daily abundance estimates to improve in-season estimates of run-size	• constraints on site selection (competing objectives – mainland pinks), and hinges on • needs input from people who are knowledgeable of the system AND stock assessment • need for 6 sets before noon
Drop one boat from Area 20 gillnet TF	• limited value of information beyond what a single vessel can achieve	• safety • no sharing of information among boats
Consideration of tides, winds currents in JS purse seines (Optimize sets based on retrospective analysis and then adjust moving forward, coupled with understanding how much this improves precision and reduces run-size error)	• improve precision of daily abundance estimates to improve in-season estimates of run-size	• constrained by need to get data to PBS • scale of enviro variables
Move towards a single Fraser River river gillnet TF site	• by improving precision of estimates of spp an age composition	• site locations, balancing seals and anthropogenic activity • pink influence • missing lower river stocks (pitt – but still have samples in marine environment) • administrative details (DFO vs. PSC) cost-sharing
Mandate/improve ITQ daily reporting of CPUE from Area 12 and 13	• to improve precision and reduce bias in daily CPUE and resulting in-season estimates of run size	• timely reporting • confidentiality • user friendly system
Coordinated collection of bio-samples samples from FSC fisheries	• Increased information on stock and spp composition, particularly early in season	• logistics • DFO focus has been on compliance and catch monitoring in Lower River.

PART 2 – MOST PREFERRED REFINEMENTS TO REDUCE FINANCIAL COST

(4) What is the preferred refinement?	*(5) Why is this refinement preferred? How will the refinement* ***specifically*** *reduce financial cost?*	*(6) What potential barriers affect feasibility of implementation? What information would be lost?*
Eliminating, or reducing, use of 2 gillnet boats in Area 20	• reduced test fishery contracting costs	• safety • no sharing of information among boats
Move towards a single Fraser River river gillnet TF site	• reduced test fishery costs by reducing the number of gillnet TF that operate	• Jurisdictional issues with DFO • Feasibility study
Use Area 12/13 purse seine ITQ data	• reduced test fishery contracting costs by eliminating TF on days when ITQ fishery occurs	• Unclear if this is logistically feasible
Develop an annual test fisheries implementation plan (small to medium to large runs; which TFs, when, etc.)	Greater certainty and efficiencies in planning == reduced costs	• Time and effort
Transferring administration of non-assessment test fisheries to the parties (reefnets, Nakka Creek, Area 4B/5)		• historical inertia, politics

PART 3 – MOST PREFERRED REFINEMENTS TO MINIMIZE FISH MORTALITY

(7) What is the preferred refinement?	*(8) Why is this refinement preferred? How will the refinement specifically minimize fish mortality?*	*(9) What potential barriers affect feasibility of implementation?*
Replace Gulf troll with sonar	• no mortality in troll TF	• effectiveness of sonar
Make purse seines release fish beyond minimum sample	• no mortality in purse seine TF	• feasibility and logistics
Transferring administration of non-assessment test fisheries to the parties (reefnets, Nakka Creek, Area 4B/5)	• reduce mortality in overall TF portfolio under the purview of PSC (but not necessarily actual mortality)	• historical inertia, politics
Use Area 12/13 purse seine ITQ data instead of TF data on days when they co-occur		Unclear if this is logistically feasible

PART 5 – UNACCEPTABLE REFINMENTS TO TEST FISHERIES PROGRAM

(17) What refinements are unacceptable?	*(18) Why is this refinement unacceptable?*
Loss of Mission hydro-acounstics	Critical information for in-season assessment, only location where absolute abundance estimate is generated
Loss of Area 12 and 20 purse seine and gillnet TFs	Critical information for in-season assessment, only places where info seaward of fisheries can be collected reliably and for which there is a historic dataset of catchability
Loss of all lower Fraser River gillnet test fisheries (but could go down to one)	Critical to generating spp and stock composition data to couple with Mission abundance estimates

PART 4 – MOST PREFERRED REFINEMENTS THAT PROVIDE BEST BALANCE ACROSS PERFORMANCE CRITERIA

*(10) What refinement provides the **best balance** across performance criteria?*	*(11) How does this refinement affect **value of information?***	*(12) How does this refinement affect **financial cost?***	*(13) How does this refinement affect **fish mortality?***	*(14) **When** could this refinement be implemented? In 2018, 2019-2020, or 2020+?*	*(15) Are there any **barriers** that might affect implementation of this refinement (e.g., knowledge / data gap, capacity constraint, funding shortfall, need for collaboration)? Be specific.*	*(16) **Why** is this refinement preferred?*
Eliminating, or reducing, use of 2 gillnet boats in Area 20	No change	Reduce, exact amount unknown	Reduce	2018	1. safety 2. benefit of information sharing	Reduced cost and mortality without loss of information
Move towards a single Fraser River river gillnet TF site	Prevent loss of information (Cottonwood) Potential gain in stock and spp composition by using more optimal location	Neutral	Neutral, possibly increase	2019-2020	1. site locations, balancing seals and anthropogenic activity 2. missing lower river stocks (pitt – but still have samples in marine environment) 3. administrative details (DFO vs. PSC) cost-sharing if including Albion	Need to refine the current suite (i.e., cottonwood, and future changes)
Use Area 12/13 purse seine ITQ data	Improved	Neutral (or reduced if TF does not operate on same day)	Neutral (or reduced if TF does not operate on same day)	HIGH priority to devise and develop a plan that is tested in 2018 (Canfisco volunteers to pilot some aspects in 2017 if there is a fishery) 2020+	1. timely reporting 2. confidentiality 3. user friendly system 4. ironing out logistics	Improve in-season run-size estimates without large cost
Coordinated collection of bio-samples samples from FSC fisheries	Increased information on stock and spp composition, particularly early in season	Increased due to collecting and processing data	Neutral	2018 (training and thinking about logistics required)	1. logistics and training	To improve samples for stock (particularly, and during times when current TFs are lacking) and spp composition
Use a coordinated evaluation of TF sites used in Area 12 and 13 to optimize Area 12 and 13 purse seine test sites, and evaluate the benefits of explicitly considering and accounting for influence of environmental variation on catches	Increased	Neutral	Neutral	2019-2020 (need to do some research first)	2. current understanding of how environment affect catch per set 3. constraints on site selection (competing objectives – mainland pinks; need for 6 sets before noon) 4. understanding of how much this would improve value of information	Improve in-season run-size estimates without large cost
Develop an annual test fisheries implementation plan (small to medium to large runs; which TFs, when, etc.)	Neutral	greater certainty and efficiencies in planning == reduced costs	Neutral to potential slight reduction	2019-2020 (but dependent on clarification of use of fish policies)	1. clarification of use of fish policies 2. non-pay fish funding sources 3. Chapter 4 negotiation	greater certainty and efficiencies in planning == reduced costs and improved planning and business relationships
Transferring administration of non-assessment test fisheries to the parties (reefnets, Nakka Creek, Area 4B/5)	Neutral	Reduced (for PSC)	Neutral	2019-2020	1. historical inertia, politics	Reduced bilateral costs to program without any loss of information

GROUP 4

PART 1 – MOST PREFERRED REFINEMENTS TO IMPROVE VALUE OF INFORMATION

(1) What is the preferred refinement?	*(2) Why is this refinement preferred? How will the refinement specifically improve value of information?*	*(3) What potential barriers affect feasibility of implementation?*
• Seaward information from Northern BC, 104 w/ timely DNA analysis, condition sampling • WCVI test fishery	• Earlier indication of timing, stock composition, and possibly abundance. • Improve understanding of fish condition for MAs	• Logistics of sample collection and timeliness of analysis – planes from sport lodges? • Time for analysis
• Start A20/12 GN earlier and on a regular date • A20/12 seines July 20th – Sept 10th on pink/late run years • Base on triggers?	• Earlier indication of timing run size, stock composition	• Need more DNA samples – limited capacity for analysis/timing
• Add additional programs such as the Gordon Group seaward with improved structure, FSC – improved info	• Earlier indication of timing run size, stock composition	• Need more DNA samples – limited capacity for analysis/timing • Need improved structure and communication
• Pattern vs free form TF • Restructure times and flexibility of test fishery to have more representative sets. • Water taxis for samples • Add data about quality of set	• More representative abundance and stock composition and timing (?)	• Would need to recalibrate expansion lines, run standard TF at the same time

• Improve late run estimate in SOG
  ○ sonar surveys?
  ○ Other new tech?
	• Better late run estimate	• Cost – feasibility of tech

• Hire new TF in A20 for training purposes (Seine)	• Need to train new TF before retirements	• Cost, finding the right ppl.

PART 2 – MOST PREFERRED REFINEMENTS TO REDUCE FINANCIAL COST

(4) What is the preferred refinement?	*(5) Why is this refinement preferred? How will the refinement specifically reduce financial cost?*	*(6) What potential barriers affect feasibility of implementation? What information would be lost?*
• Remove cottonwood but increase samples at Albion and Whonnock (longer net/ extra panels) • Reduce time	• Would reduce in-river test fishing costs, though some costs would increase in other TF.	• Estimating Pitt + stock comp – use FSC fisheries to increase samples? • Katzie fishery for TAC • Extra sets @ Whonnock? • Not necessary big savings
• Reduce # of days @ A13, more flexibility – extra fishing on abundant years • Supplement w/ FSC	• Pay less for TF in low run years, run in years when it is more likely to pay for itself	• TF contracts would need to be more flexible • Need coordination of FSC info • Would need it in pink years. A13 would indicate CM can start
• Reduce/replace A4b5 with CNS info in low years	• No need to pay for T.F. (though still need organizing/samples)	• Stock ID
• Shorten T.F. (similar to 2016). End TF early – be flexible, use trigger to begin / end	• Fewer boat days	• Need to standardize trigger – transparent plan. Will be difference when pink are around
• Eliminate reef net in yrs with no TAC	• Fewer boat days	• Need to use to switch over to pinks
• Remove Naka (Round Island is most seaward)	• Fewer boat days	• Less info for CM

PART 3 – MOST PREFERRED REFINEMENTS TO MINIMIZE FISH MORTALITY

(7) What is the preferred refinement?	*(8) Why is this refinement preferred? How will the refinement specifically minimize fish mortality?*	*(9) What potential barriers affect feasibility of implementation?*
Reduce GN set times to 15 – 20 min in order to release fish with lower mortality	• Release sox, higher likelihood of survival	• Would change catchability • Could not take as payfish • Need to sample anyway
Use seines instead of GN – small seines in river	• Can spill non-sample fish with lower mortality	• Would have to test, recalibrate • Would change expansion, miss certain stock?
Have money for test fishery, no pay fish	• Only retain sample fish	• need money from countries
See "cost reduction" strategies (last page), lower TF, shorter programs, etc.	• Fewer fish caught, therefore killed	• Less info
Use reefnets where possible – US – continue with existing program	• RN have low/no mortality but still provide timing /abundance info	• Can't be used everywhere

PART 5 – UNACCEPTABLE REFINMENTS TO TEST FISHERIES PROGRAM

(17) What refinements are unacceptable?	*(18) Why is this refinement unacceptable?*
• Removing: ○ Whonnock TF ○ A12/A20 PS ○ any core test fisheries ○ need TF when switching to pinks • Add Chatnam Pt • Round Island – need because most seaward	

PART 4 – MOST PREFERRED REFINEMENTS THAT PROVIDE BEST BALANCE ACROSS PERFORMANCE CRITERIA

*(10) What refinement provides the **best balance** across performance criteria?*	*(11) How does this refinement affect **value of information?***	*(12) How does this refinement affect **financial cost?***	*(13) How does this refinement affect **fish mortality?***	*(14) **When** could this refinement be implemented? In 2018, 2019-2020, or 2020+?*	*(15) Are there any **barriers** that might affect implementation of this refinement (e.g., knowledge / data gap, capacity constraint, funding shortfall, need for collaboration)? Be specific.*	*(16) **Why** is this refinement preferred?*
Have flexible programs + policy predictable Have specific programs 2016 program – low sox Low sox – pink yr – ex < 2M sox – 2017/2019 High sox - 2018	Be flexible, but collect info as needed	Start with a minimum program	Responsive program, reduces mortality in low years	All years	• Need improved data collection – such as better understanding of the T.F. data – tides/currents • TFisheries need to be flexible	React to conditions/run size
High sox (ex 2018) • more DNA sampling • Start TF earlier, go later • Keep all current TF • Expand seaward	• Better idea of timing/abundance, planning CM. • Consistent indicators	Payfish can likely cover in big years (at least some)	N/A	2018, 2022, etc	• Need longer data sets to make use of the Seaward data – need to learn from older T Fishers • Early signal allows earlier CM fisheries	More info
Low/med sox w/ pink • Start /end later • Remove Naka • Remove 4b, 5, 6c • Add pink RN		Saves boat days	Fewer fish caught/killed	2017, 2019 etc.	• Less certainty on run size/timing • What of larger? • Higher risk	Balance info and money
Low sox (NoTAC) • No A13 • Shorter duration • No Naka • No 4B, 5, 6C • No RN • No cottonwood	Less info	Saves boat days	Fewer fish caught/killed	2016, 2020 etc.	• Might lose info, longer term data sets not as good • Hard to respond to early season signals	Save money

GROUP 5

PART 1 – MOST PREFERRED REFINEMENTS TO IMPROVE VALUE OF INFORMATION

(1) What is the preferred refinement?	*(2) Why is this refinement preferred? How will the refinement specifically improve value of information?*	*(3) What potential barriers affect feasibility of implementation?*
Marine Hydro acoustics to assess late run sockeye in Strait of Georgia (Adams dominant years)	• Assess late-run sockeye; holding fish	• Unknown feasibility of hydroacoustic survey • Species/stock ID needed? • cost
More seaward info-use FSR fisheries from Gordon Group (can be provided in timely fashion) – stock ID	• More seaward information ○ couple days more seaward ○ Stock ID	• No current fishery • Quality of data-fishing in consistent manner • Add to data Catherine presented
Scale up FSR fisheries on WCVI to be used to get more seaward abundance	• More seaward information ○ couple days more seaward ○ Stock ID • 3-6 days more seaward depending on location	• Quality of data • No current fishery; longer time period to build useable dataset
ITQ data – better data flow in season	• Confirm TF • Use TF and 12	• Turn-around – timely info • representative
Mark-recapture sockeye study Tag in 12-recover in 13	• estimate catchability/expansion lines, in-season, harvest rates, stock ID	• cost

PART 2 – MOST PREFERRED REFINEMENTS TO REDUCE FINANCIAL COST

(4) What is the preferred refinement?	*(5) Why is this refinement preferred? How will the refinement specifically reduce financial cost?*	*(6) What potential barriers affect feasibility of implementation? What information would be lost?*
• Remove area 13 PS A20 GN Johnstone GN	• Big financial cut • Use area 12 alone	• Potentially increased risk • important in late-run • Risk not realizing total TAC or under/over estimating runsize • Reduced capacity to detect when runs are low • Cost recovery reduction
• Remove 1 boat area 20 GN	• Cost • Minimal impact on run size	• High abundance-increased variability • Data quality
• Remove all • TF not used in run size estimates • 4B, Reefnet, Naka Cr.	• Cutting TF's reduce cost • Supplement w/ commercial fisheries info (ITQ) or C&S fisheries • Or FSC fisheries	• Acceptable reduced info? Risk • Reduced certainty of abundances for specific areas (fisheries)
• Data substitutions – FSC/commercial/ • C & S Fisheries in place of TF info • Utilize small bite commercial fisheries	• Cut costs – replace TFs	• Need TAC (commercial) • FSC – data quality • Long-term commitment • Calibration
• In-river TF –use FSC info	• Cut cost	• FSC – data quality; barrier to entry lower in-river
• Reduced schedule – delay more expensive TF after less expensive (GN)		• Reduce information

PART 3 – MOST PREFERRED REFINEMENTS TO MINIMIZE FISH MORTALITY

(7) What is the preferred refinement?	*(8) Why is this refinement preferred? How will the refinement specifically minimize fish mortality?*	*(9) What potential barriers affect feasibility of implementation?*
Removing TF – if info replaced by FSC fisheries already occurring-particularly GN	• Save costs and fish	• Impacts on info
Use gear that permits release ▪ reducing GN soak time	• Save costs and fish • Able to release fish- increase FIM, decrease total morts	• Comparable to old fishing methodology data? • Calibrating
Remove all GNs – only PS	• Costs and fish	• Reduced info • Reduced revenue capacity
• Retention strategy – adjust retention based on runsize or other in-season info • Avoiding stocks of concern? • Delay startups or re	• Prioritize retention • Conservation benefit	• Stock ID • Balance between reduction and level of risk

PART 5 – UNACCEPTABLE REFINMENTS TO TEST FISHERIES PROGRAM

(17) What refinements are unacceptable?	*(18) Why is this refinement unacceptable?*
Remove Area 12 & 20 GN & PS	• Needed for runsize assessment
Remove all GN TF – marine and in-river	• Variety of reasons-reduced info for in-season assessments, stock ID etc.
Remove in-river GN TF	• Increased variability – diminish value of acoustic info

PART 4 – MOST PREFERRED REFINEMENTS THAT PROVIDE BEST BALANCE ACROSS PERFORMANCE CRITERIA

*(10) What refinement provides the **best balance** across performance criteria?*	*(11) How does this refinement affect **value of information?***	*(12) How does this refinement affect **financial cost?***	*(13) How does this refinement affect **fish mortality?***	*(14) **When** could this refinement be implemented? In 2018, 2019-2020, or 2020+?*	*(15) Are there any **barriers** that might affect implementation of this refinement (e.g., knowledge / data gap, capacity constraint, funding shortfall, need for collaboration)? Be specific.*	*(16) **Why** is this refinement preferred?*
Remove TFs not used for sizerun assessments	Neutral on runsize assessments • Information for fisheries openings	Reduce costs	Reduce morts	Now	Regional information for fisheries openings	Significant cost reduction w/o effecting
• Subs. FSC/comm/ C & S fishery info for TF -------------------------------- • Use alternative gear to trigger TF's	Unknown - TBD	Reduce costs	Reduce morts (if FSC fisheries occurring regardless)	• Long term need for calibration • Data flow	• Some dependent on TAC • Data quality • Investment – return on investment unknown • Buy-in by fishers • Capacity constraint – getting fishers trained, logistics • Collaboration - communication	• Large potential long-term benefit • Cost savings
Augment current TF info w/other fishery info	Increasing value of info	Neutral or small	Increased or neutral	Long-term	• similar to above	• Increased info at minimal cost • Inform potential for subs.

Attachment G: Summary of Potential Refinements from Workshop #2

Area 12/13

- Complete assessment of A12/A13 purse seine TF sites and remove sites providing "poor" information
- Current SEF projects Johnstone Straight re (DFO / PSC): (1) localized tides / currents and (2) Fish behaviour / distribution
- SEF project: Evaluate Johnstone Straight seine TF patterns, additional set, locations, weather, tides to improve abundance estimate
- Quantitative examination of the influence of tides on catch per set in Area 12/13 purse seine test fisheries....then quantify extent to which accounting for a "tide" effect improves in-season run size assessments
- SEP proposal: Add 2/3 additional sets to Area 12 assessment sets using knowledge of tide and currents and weather. Evaluate if this would improve daily abundance estimates.
- SEF proposal: Repeat analysis of Area 12/13 test fishing locations using tide and current information. Note use standardised residuals instead of actual CPUE data
- Add expert knowledge on fish migration patterns / distribution to design of Johnstone Straight seine test fishery. Locations / daily schedule (e.g., tides, geography, currents)
- Tides and currents. Need more understanding how they move, the flow of stocks
- Supplemental SEF project reconfigure Johnstone Straight seine test to fish during those times (tides) that would most closely optimize catch
- Maintenance of A12 and A13 TF as it appear the combination tends to improve our understanding of inseason abundance. Also A13 provides a validation function of A12 TF – are we seeing the same or something different.
- One way to include tides, weather, etc is to continue A13 TF, blended with A12. I think this fishery accounts for some of the variation caused by tides / weather or behaviour of fish in A12 and A13.

Commercial fisheries

- Develop in-season catch by set info / reporting system for seine ITQ fishery
- Improved ITQ info for Johnstone Straight
- Design 1 or 2 alternative data collection schemes for ITQ purse seine commercial fishery that could be tested in 2018 and apply to SEF for 2018 support
- One should be considering a design that is modified based on environmental factors – subset or all skippers in the design record suite of environmental variables
- Further exploration of optimal use of purse seine ITQ data (E.g., just those vessels that do beach set, or early sets, or can report on a daily basis) and feasibility of daily reporting (could be piloted in 2018, possibly expanded to include FSC fishery too)
- Compliance in catch monitoring for more timely and accurate information all users, late reporting example.
- Need to seek regulatory enforcement of catch reporting in order to establish accurate and reliable CPUE data to inform alternate run size models from commercial fisheries
- Put some already identified "needs for infor" into motion for upcoming years: include more / ask for more qualitative information to accompany test sets such as tide and fish behavioural info, ITQ catch / set info for 2018.
- Require real-time (potentially electronic) reported by all-fisheries.

- Need to reassess our risk tolerance policy to allow commercial opportunities regardless of how small to obtain "free" abundance data
- ITQ fisheries. Good information, just don't know how to use it.
- Catch reporting by companies.
- Logbook catch / set data in season (Elog / something??). Condition of license associated with commercial fisheries. Provide incentive to provide that level of data (based on Jim Cave's work and the need to further explore the value of that quality of data)
- Given data available inseason from the CA purse seine ITQ fishery, look into requiring more detailed information from fishers inseason. Could be voluntary with an incentive to report
- Confirm / review data in ITQ fishery analysis. If appropriate, consider incorporating ways ITQ data info assessments.

FSC / C&S

- Use FSC catches for Stock ID (particularly in river)
- Coordination of FSC fisheries in Gordon Group and Johnstone Straight for 1-2 weeks around peak of Summers – May need SEF funding for 2018
- Use small bite commercial fisheries as confirmation of test fisheries in Johnstone Straight (<5000 fish). Could be FSC and operate regardless of forecast run size.
- SEF dollars to support exploration of using FSC data to inform run size assessment etc (from Areas 12 and 13) and seek input on where else this would be useful.
- Try to incorporate AFS catch data to supplement daily test fishing into run size models
- Need to utilize information on catch in all fisheries that are occurring (FSC GN / SN in Canada, C&S in US)
- Explore possibility of using data from FSC fisheries especially in A12 and A13. Can we get set by set information from some test fishers?
- Additional stock ID sources? Recreational fish in A29. FSC in areas where TF aren't occurring.

Marine hydroacoustics

- A marine hydroacoustic site like that suggested for Chattam Point seems like a non-starter because of environmental concerns (orca – marine noise) and the cost. While refinement of thoughts around use of commercial vessel mounted acoustics might warrant some further assessment.
- Drop Chattam Point / Seaward hydroacoustics
- SEF project: Acoustic estimate of delaying gulf sockeye 2018
- Use of sonar in the Gulf instead of troll info for sockeye (more efficient)
- Evaluate use of marine echo-sounding
- SEF proposal: Use marine echo-sounding to evaluate delay of late run
- Marine Area hydroacoustics program at Chatham Point. This program will face significant environmental policy and monetary costs.
- Drop Chatham Point hydroacoustics. Marine mammal impacts and general (in-feasibility) and limited potential usefulness.
- Stop evaluating marine hydroacoustics in Johnstone Straight as too costly and huge issues on implementation and species ID.
- Discontinue discussion regarding Chatam Point hydroacoustics.

In-River

- Compare marine TF estimates of Pitt to marine and cottonwood combined estimate

- SEF dollars to support assessment of adding sockeye panel(s) to Albion net. Compare data within Cottonwood. Assess implication for Pitt assessment
- In river test fisheries (Cottonwood, Whonnock, Albion): Need a value of information assessment equivalent to marine TFs. If opportunities to improve – do a feasibility, logistic, and cost assessment. Information on stock and species composition related to hydroacoustic review.
- Analysis of value of information for in-river test fisheries as was done in marine area
- Let Qualark go away
- Cost benefit for Cottonwood is not fully accounted for in the assessment provided. Yes there is revenue generated but there are additional cost for maintenance across years that were not included in the $103K (e.g., the electric net)
- Drop Cottonwood, + add additional sockeye sized mesh panels to Whonnock and Albion
- Qualark – keep or drop based on hydroacoustic review decisions
- Quantitative evaluation of in river GN options. (1) Pitt Stock ID: Cottonwood vs. Marine moved in. (2) Sockeye sample size: Cottonwood vs. Whonnock + Albion vs expanded Whonock + expanded Albion. If Qualark hydroacoustic site and TF is kept (via hydroacoustics review), quantitative evaluation comparisons of stock ID assumptions re: migration timing, etc.
- Modification to Albion would appear to be outside scope / infeasible to pursue in reasonable time frame given breadth of consultations required. If Changing Whonnock or Cottonwood more likely to ???? with something else.
- How useful will Cottonwood be when the new Fraser crossing is built? Will greatly impact an already compromised test fishery (e.g., river traffic, seal predation, etc). Perhaps move the site upriver to include salmon transiting the North Arm.\
- Design and cost single location lower river GN test fishery to satisfy all species data needs.
- Provide range of revenue from individual Fraser GN test fisheries
- SEF retrospective of the Cottonwood TF, if not conducted what does it mean for in-season management
- Abandon refinements / restructuring of in-river test fisheries due to infeasibility and unlikely cost savings
- Cost savings: Eliminate Cottonwood and add sockeye meshes to Albion and maybe Whonnock to increase sample size
- More analysis required from in-river test fisheries analysis if change are going to be considered. Helpful to understand the impacts (bias and precision) on removing or altering a TF.
- Explore adding sockeye panels at Albion and eliminating Cottonwood. Explore relationship between estimates of Pitt abundance with estimates from Cottonwood to help inform. If a "go" assess continued need for Whonnock.

Naka Creek / Round Island

- Determine realistic cost of Naka Creek GN to operate for similar length of time as Round Island. When sufficient database is obtained, replace Round Island test with Naka Creek.
- SEF proposal: Apply for funding to extent of Naka Creek test fishery for the full duration of the GN test fisheries.
- Naka catchability
- Deploy Naka in high abundance years as part of commercial TAC (no cost)

Seaward information

- It appears that most seaward indicators have been ruled out (ie. D104 & 2W). If not what additional uses of these data should be quantified / explored? Can years when such information is useful be predicted?
- Gordon Group catchability
- Doesn't seem like there is too much value continuing seaward analysis given today's presentation.

TF evaluation methods

- Zero based budgeting approach to developing a "suite" of test fisheries (i.e., start with no TF and only Mission hydroacoustics, then analyse adding individual TFs separately; then combinations
- Can we quantify how any particular refinement would impact confidence in existing test fishery indicators? If so, how? What additional types of analyses would be needed? Should be pursued? Consistent direction? Consistent magnitude?
- Develop a new model utilizing tide and weather data to complement existing PSC run size estimation model. Thus, attempting to mitigate sudden drops or increase resulting from TF catches that have the effect of unrealistic changes in run size.
- Differentiate between valuable qualitative vs. quantitative info / data in-season (e.g., tides/currents). Not everything needs to be in a model (at least not right away), but a more formal mechanism for incorporating observations. Summarize comments from test fishermen to add to Panel conversation.
- Would like to see more communication with commercial sector before some of the retrospective analysis is done. They may be able offer some infor that did not show in the data.
- Are there any ways to incorporate marine tides, currents, weather, etc to sure up marine area test fishery information and how it relates to daily abundance? (New research, SEF proposal)
- Determine which changes are very unlikely to happen and shift focus away from them. Ex. Not likely to drop any in river TF?

TF deployment strategy

- Consider shift in management paradigm that would substantively reduce reliance on test fishing. In other words utilize some small scale, wide spread systematically implemented FSC or commercial fishery in lieu of test fishing and couple that info with mission info.
- Should a minimum TF plan be set for years of low abundance (non-pink years maybe) and then increase the TF schedule when high or moderate years are forecast?
- Ability to add TF when needed in season for some years (e.g., when on the cusp of ID'ing TAC for fisheries). Step 1: ID international TACs. Step 2: ID Canadian commercial TAC. Corollary: What's the minimum TF needed to ID TAC at early part of large abundance years (i.e., 2010 cycle). E.g., Could you get ¾ of the way through the season with GN and A29 Troll only?
- Continue to "fine tune" start / end, dates of test fisheries to align with / reflect anticipated returns. Standardize approach for low abundance, etc.
- Flexibility: Abundance or lack of verification in SN TFs (a) test skipper sets at prescribe site: Catch = 0 near observes fish offshore = should make set (b) test skippers observe environmental conditions (wind tide current) far not conducive to fish being present in abundance in normal test fishing zone. Should be permitted / required to make test sets in alternate area where fish are likely to be present. (c) Funded program to engage a 2nd test boat in "freelance" test sets / locations based on knowledge of probable abundance locations (i.e., tide/current/wind, etc).
- Set up minimal baseline Test Fisheries program based on preseason forecasts that can be extended as needed.

Other areas

- Need to allow for Area H sockeye allocations to be caught by 2 to 4 dual licensed H&F trollers to provide timing and stock ID off of Hada Gwaii in areas 2W
- Area D 35 eloggers in 2016, 38 in 2015. We heard that timely logbook info (Cave Report) could be used for better in-season run size assessments. This could include set by set in formation. Best approach for doing this could be electronically. Submit SEF proposal to have a sub sample of a fishing group (GN, SN or Troll) to do this and provide the necessary data to do the required modelling in a timely fashion. Potential candidate could be Area D. They may have electronics to transmit data.
- Newish TF, Roller Bay
- Tribal reef net fishery harvesting tribal ceremonial and subsistence sockeye that can be used to assess run size and timing.
- Question remaining reefnets. All three reefnet test sites tell us the areas in US Area 7 where commercial fishing can take place on the main 3 migration avenues with the best result. Also genetic samples can be and have been taken in reefnets in US waters to give us the mix of stocks in our water on the major migration corridors.
- SEF proposal for coordinated Troll TF in 2W with 2-4 boars over 4-6 week period starting at north tip of Vancouver island and move north, then back down to Vancouver island
- Area D 10 boat assessment compared to abundance (not compared to Round Island, which was the original evaluation done in 2008). Able to combine with Naka Creek data?
- Predators beginning to be a problem
- Using commercial CPUEs in Area 7 and 7A (US) to inform run size and timing
- Although not popular domestically, test fisheries used primarily for domestic purposed may need to be eliminated. Qualark, A7 Reefnet, 4B/5 GNs. In their place (A7 RN/ 4B / 5GN) could strategically utilize ceremonial and subsistence fisheries which are very low impact but provide similar information on local distribution of fish in these waters.
- More information on likely cost savings from 1 vs 2 boats in Area 20
- Area 4/B/5/6 TF evaluation. Any use to combine with A20?

Costs/Funding

- Consider supplementary funding source through "conservation fee" on landings
- Seeing as we talked about costs, to be sustainable you need to have to be able to get the most dollars from the test fish proceeds as possible.
- Would like to see net costs of TFs to weigh against the value of the data we are getting from each

Data collection

- Data enhancement: Mandatory set by set catch reporting in SN fisheries. Program should be developed that either (a) requires all vessels mandatory reporting or (b) select % of fleet are required to submit daily set by set catch reports. Could be accomplished by incentives....funded program or catch incentives. Environmental conditions reporting. Part of reported catch data would be personal observations of environmental conditions affecting each set. (a) what were conditions – tide/wind/current? (b) did you expect a good / poor catch given the conditions? (c) given conditions did you feel you should have set in another location?
- Knowledge of test fishery captains
- Systematically collect and report on more details in TFs. E.g., Open set or no with seines, weather and tide conditions, etc. Record in a way that will enable analyses at some point in the future.
- Tide and weather: historic and current weather data exists. Explore metrics to relate to relative CPUE.